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Machines or shelves?

The state of near-saturation in consumer products is forcing the Australian electronics industry to get up off its haunches in a bid to survive. In some directions, the changing attitudes are to the good.

Considerable pressure, for example, has been brought to bear upon the Federal Government and its instrumentalities to make full use of local technology, instead of simply buying from overseas sources. There is reason to believe that this is producing results.

Again, there is a refreshing concern within the industry to publicise its activities and achievements. For decades, publicity has been largely confined to advertisements extolling the virtues of consumer products. Engineering achievements have received scant mention. This has been in strong contrast to the attitude of overseas companies, with their consistent output of technical pictures and interesting, readable stories.

At long last, Australian companies seem to be waking up to the value of technical publicity to propagate the idea that we can do it here!

On the debit side is a tendency to import an increasing number of sub-assemblies, generally for reasons of convenience, and to integrate them with local components. This takes up some of the strain of competition, which is further eased by lucrative agencies for fully manufactured items.

The Government makes this possible, on the broad basis that the nation must buy as well as sell. Financially, adjustments can be made by regulation but technology cannot be manipulated so readily. If industry indulges too freely the let-out of importing items which are inconvenient to make, it will sacrifice skills and drift away from true manufacture.

This is a managerial as much as a governmental responsibility. Right now, imports are sustaining turnover within the industry but we must, very deliberately, keep alive the art of making such things ourselves, as an investment for the future.

In short, we must be careful how many machines we move out to make room for shelves!

N. Williams

uly, 1966

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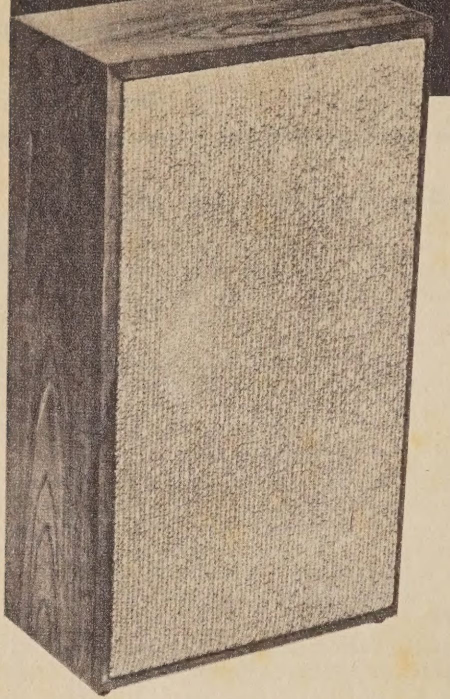
COVER PICTURE: A diffraction grating made at the C.S.I.R.O. Division of Chemical Physics, Clayton, Victoria, is used to split up a beam of light into its component colours. A smoke haze has been used to show up the light beams. A number of spectra can be seen on either side of the zero-order reflection, although the grating is "blazed" for the first order spectrum to the left of the zero-order. (Photograph by Mr F. Lugton, A.R.P.S.). Story follows on page 8.

INSTROL.



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Quality audio furniture, tailored to suit the equipmen of your choice, and most economical. There are ove 20 equipment and speaker cabinet designs, each availabl built and polished or in kit form to build yourself. A left is the remarkable Book-shelf speaker system. Originally designed by this magazine, the reproduction i unbelievable from so small a unit at so little cost. Only 19¼in x 11½in x 6 1/8in. A free catalogue is availabl detailing the full range of Instrol cabinets.

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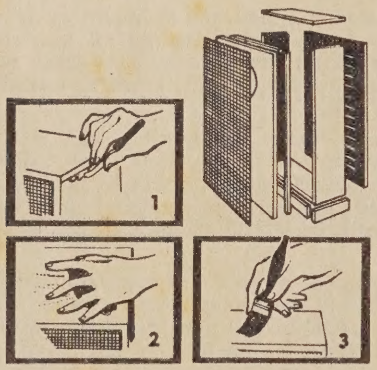

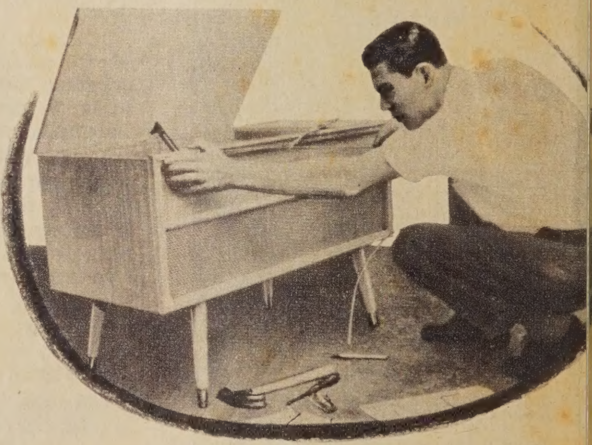

Finishing and polishing your cabinet is quite simple. If you can paint you can polish. For a beautiful Queensland Maple finish there are just three easy stages in which no skill is required. (1) Putty and then sandpaper the nail holes. (2) With a cloth first rub on, then wipe off the filler paste. (3) With a brush, apply three coats of Estapol or similar.

Polishing kits with instructions are available for Qld. Maple, Walnut, Rosewood, Scandinavian Oil Teak, etc.

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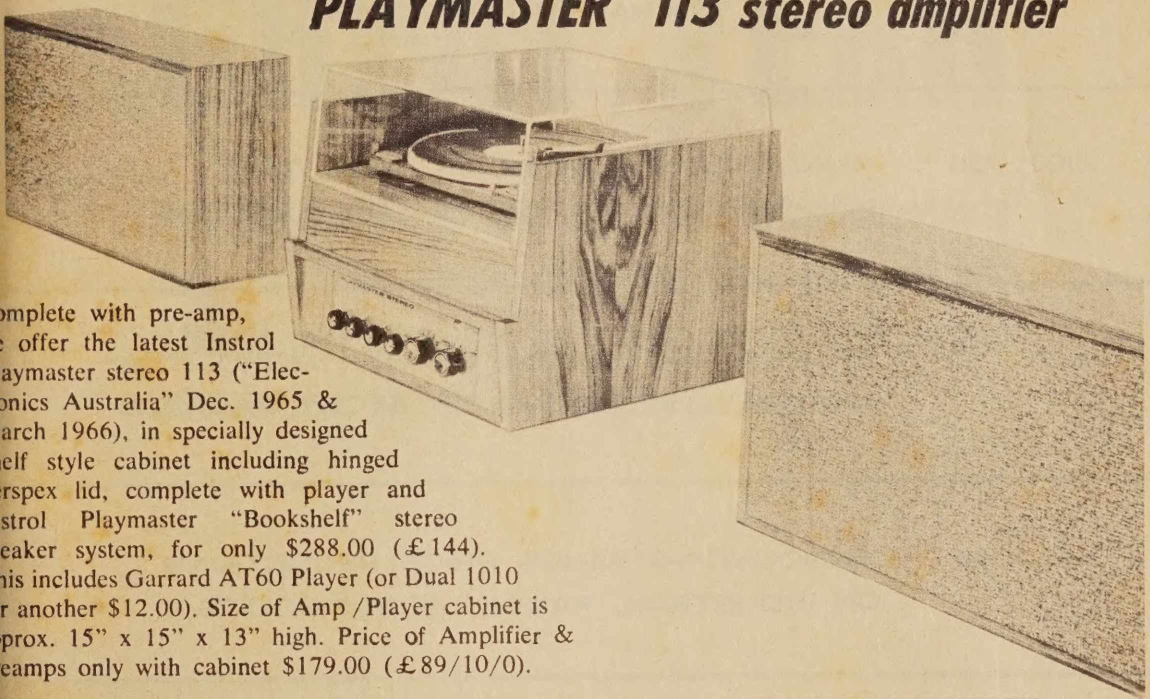

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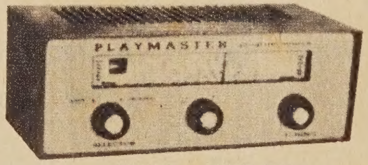

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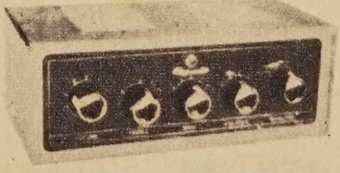

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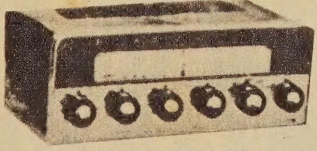

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FCNC

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Listen to your Macquarie station: 2GB/3AW/4BH/5DN/6IX-MD-BY/7LA
A CONTEST FOR ALL THE FAMILY COMMENCING JULY 1

Entry forms available at all Record Stores and Fisher dealers

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2GB Sydney	**5DN** Adelaide
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from July 1st to July 29th.

Tunes from a show will be played throughout each day, Monday to Friday during the whole of July. A different show each day! 21 shows will be featured altogether. Name as many of the Shows you can! Do *not* name the *tunes*. Every member of your family can enter the *"RCA Name the Show" Contest* and all entries may be sent in one envelope! Full details are on each entry form.

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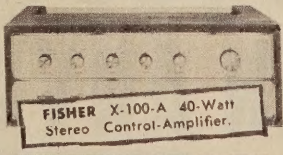
ELAC Record Changer
FISHER Amplifier
2 FISHER Speaker Systems in cabinets
TOTAL VALUE $600



FISHER X-100-A 40-Watt Stereo Control-Amplifier.

2 **FISHER** XP-5 Ultra compact Free-Piston Loudspeaker Systems in cabinets.

ELAC Record Changer in Cabinet.

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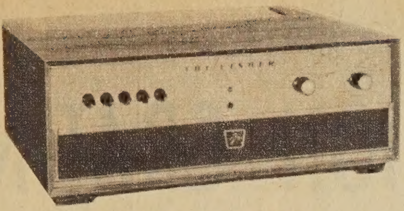
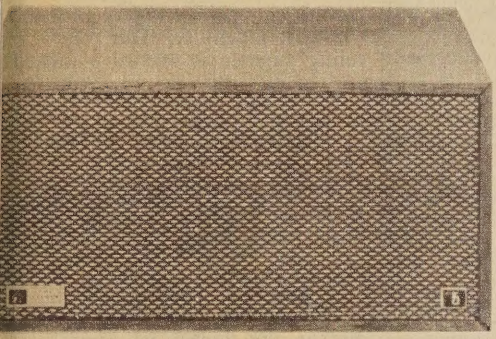


The Fisher X-101-C
60-Watt Stereo Control-Amplifier

with heavy-duty output circuitry, exclusive hinged cover over the less frequently used controls, centre-channel output for optional third speaker, front-panel headphone jack, complete phono and tape facilities: $296.

The Fisher X-100-A
40-Watt Stereo Control-Amplifier

With large output transformers, advanced control features, front-panel headphone jack, complete phono and tape facilities: $240.



The Fisher XP-5
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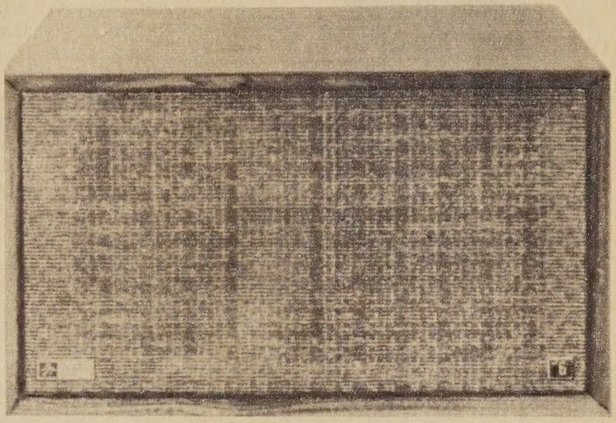
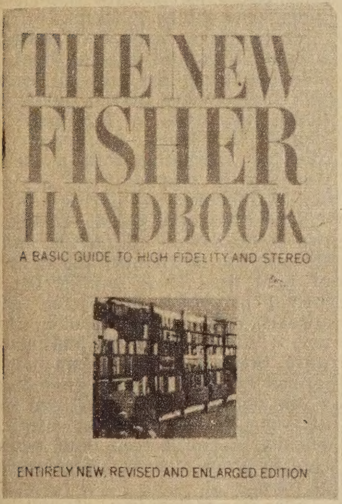
with 8" low-resonance woofer, 2½" wide dispersion tweeter, 2000-cps crossover, clean response down to 38 cps: $98.



The Fisher XP-6
3-Way Free-Piston Loudspeaker System

with 10" low-resonance woofer, 5" midrange speaker, exclusive 1½" soft-dome tweeter, 300 and 2500 cps crossovers, response 35 cps to beyond range of audibility: $152.

Buying stereo? The first thing you need is free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DIFFRACTION GRATING

Thirty-two thousand lines to the inch — not Super TV of the 21st century but a diffraction grating used for splitting light into its component colours! Although one of the most venerable of all optical instruments, the diffraction grating has proved perhaps the most tantalizingly hard device to make. And you will see why when I lay down some of the necessary specifications for a good grating. The ultra-precision demanded in this micro-inch engineering is probably as demanding as any challenge to human ingenuity. The "club" of those who have made successful ruling engines is exclusive indeed!

By C. K. Coogan, M.Sc., Ph.D.

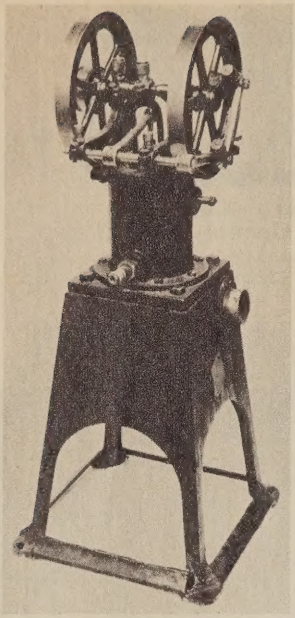


Figure 7a: The gas-powered engine used to drive Grayson's original ruling engine. (Photographs by courtesy of G. Bell, C.S.I.R.O. National Standard Laboratory, Sydney).

Australia has had an interesting and important part to play in the history of diffraction gratings. In recent years Techtron, an Australian optical instrument firm, has begun manufacturing and marketing, both here and abroad, an Australian-made monochomator incorporating a diffraction grating. The manufacture of the gratings, and indeed the monochromator, has developed out of work done at the C.S.I.R.O. Division Chemical Physics, formerly located Fishermen's Bend, but now housed the new David Rivett Laboratory Clayton, beside the Monash Univers

Perhaps our story should start wh the principles of diffraction, before pi ing up the threads of Australia's c tributions to the art.

Sir Isaac Newton is best known the discoverer of the principles gravity, but he is also the father modern optics. Ever since he laid basis of the science of spectroscopy observing that white light is spilt in component colours by a prism, battle has been "on" to discover bet means of separating a light beam into component wavelengths.

The classical means is a prism, wh depends upon optical "dispersion," the difference in refractive index for d ferent wavelengths of light, so that lig of differing wavelengths is bent by d ferent amounts by a prism.

There are a number of reasons w a prism is not in general ideal, a n able one being the growing scarcity very high quality optical quartz cryst which are used in high-grade instr ments. In theory, diffraction gratin offer an alternative with a lot of a vantages; in practice there are a nu ber of difficulties in making gratings.

The diffraction grating depends up two principles — diffraction and int ference. Let us consider the basic natu of light first. It is one of the fund mental paradoxes of physics that lig appears to have the character of a pa ticle (called a photon) and also of wave. Some experiments can best be d scribed by the "photon" approach (su as the photo-electric effect) and some the wave picture (such as interferenc actually we must hold both pictures light in order to have an adequate poi of view.

For the explanation of how diffra

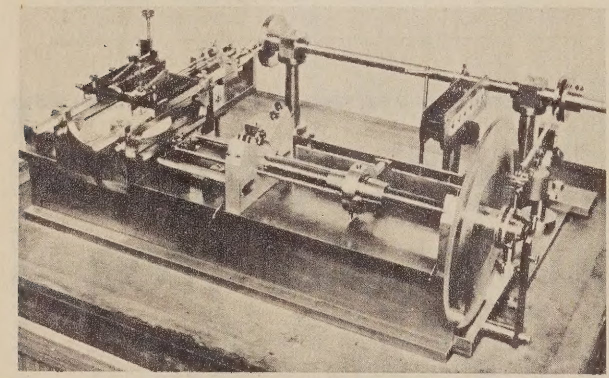


Figure 7b: Grayson's ruling engine as it is today, after several modifications.

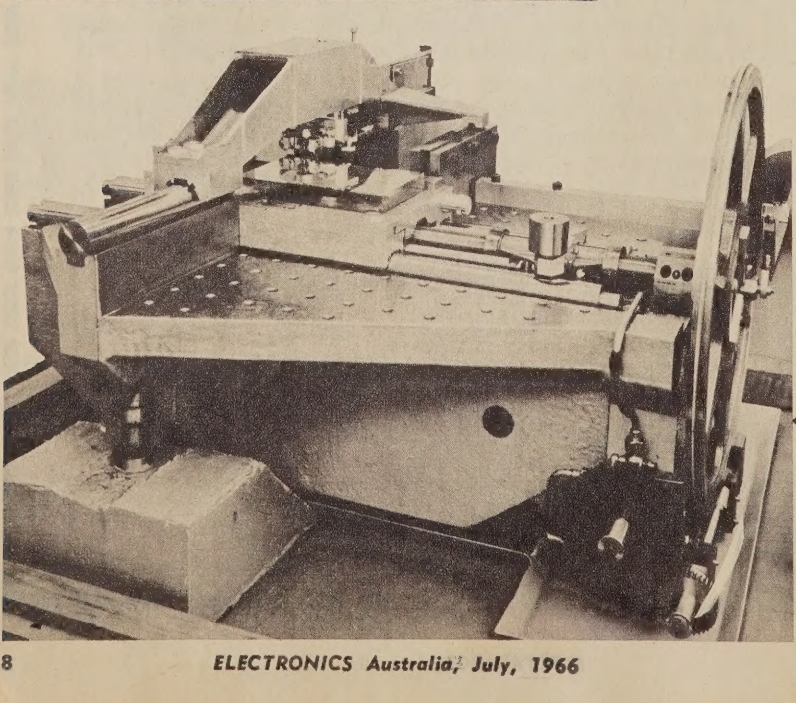


Figure 10: The C.S.I.R.O. diffraction grating ruling engine in the Division of Chemical Physics, Clayton, Victoria. The engine is housed within a temperature controlled shell when in use. The massive concrete base is set on a special vibration-free floor.

on gratings work it is best to consider
ght as being the same kind of electro-
agnetic wave as the radio wave, which
represented diagramatically in figure
. As the light ray travels along a
traight line at a velocity c, the electric
eld associated with it varies in a sinu-
oidal fashion, as shown in the diagram,
e distance between successive maxima
r minima being usually denoted by
mbda, the wavelength.

When two beams of light of the same
avelength and the same phase are
uper-imposed their effects is additive
figure 1a) but, if half a wavelength out
f phase, they tend to annul one an-
ther. If the two beams are of equal
ntensity they annul one another exactly
figure 1b). These effects of reinforce-
ent and annulment we call "interfer-
nce."

Diffraction is an effect which takes
lace when a light wave hits objects of
imension of the same order as the
avelength of the light. In this case new
ight waves are radiated in all direc-
ions as if they originated at the small
bject, as shown in figure 2.

If one draws a line through all the
oints at which the outgoing rays are in
hase, the line is a circle. It is very
asy to see this kind of effect when
aves in a pond hit small objects; the
ame kind of secondary wave radiate
rom the objects as in figure 2. If
e draw a set of concentric circles
hrough the positions at which the
econdary light wave reaches its
axima, these are just one wavelength
part.

Now consider in figure 3 a diffraction
rating which is a row of very closely
nd uniformly spaced "objects" on a sur-
ace, each of which re-radiates light as
id the single diffraction object of figure
.

Assume that an incoming beam of
ight of wavelength (lambda) strikes the
rating at normal incidence, so that all
ncoming rays are of the same phase
t the surface of the grating. It follows
hat all the outgoing subsidiary waves
ill be of the same phase at the surface
f the grating, and we will assume for
implicity that the electric field of the
ave is a maximum at the grating. Thus
he next maximum will occur at exactly
ne wavelength from the grating.

As these subsidiary waves from ad-
acent objects travel out from the grat-
ng their electric fields are super-impos-
d and interference takes place. The
aves reinforce one another in direc-
ions in which they are all exactly in
hase, or out of phase by an exact mul-
iple of one wavelength.

All the subsidiary waves reinforce one
nother in a direction normal to the dif-
raction grating, i.e., they are reflected
long the path of the incoming wave.
ut there are other directions of re-in-
orcement, such as that for which the
aximum at the surface of the grating
t one diffraction object is in phase
ith the first maximum out from the
rating due to its next door neighbour
s in figure 4. If the distance between
rating lines is b, and the angle between
he outgoing reinforced beam and the
ormal to the grating is theta, then

$$\sin\theta = \lambda / b \quad . \; . \; . \; . \; . \; (1)$$

More generally, there can be rein-
orcement between the maximum at the
rating and the Nth maximum out from

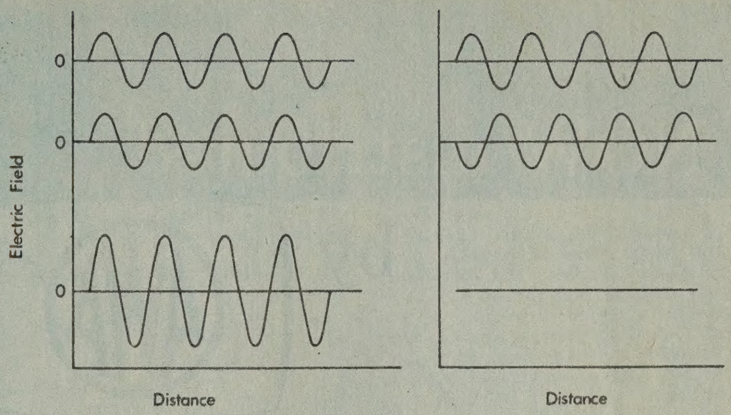


Figure 1: (Right): two light waves, of the same phase, travelling along the same path reinforce one another to form a more intense beam. (Left): two light waves, of opposite phase and equal amplitude, travelling along the same path annul one another.

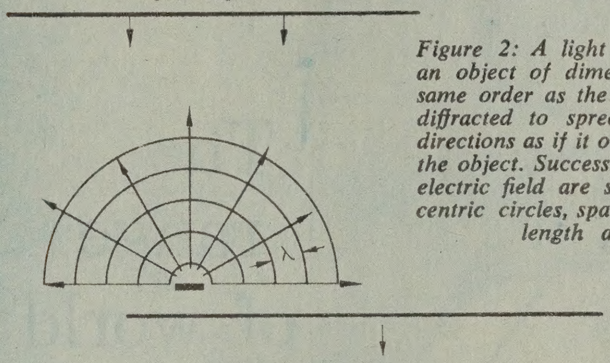


Figure 2: A light wave striking an object of dimensions of the same order as the wavelength is diffracted to spread out in all directions as if it originated from the object. Successive maxima of electric field are shown as concentric circles, spaced one wavelength apart.

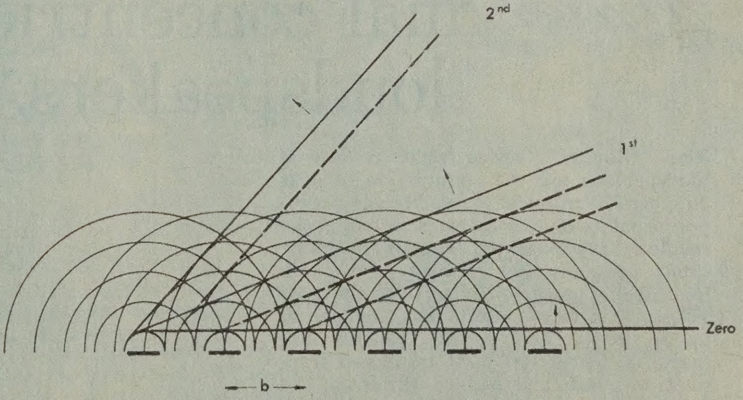


Figure 3: A diffraction grating consisting of a row of objects regularly spaced distance "b" apart, which diffract an oncoming light-wave. Successive maxima from the same object are shown as in figure 2. The direction in which these maxima reinforce one another are shown, for the zero, first, and second-order beams.

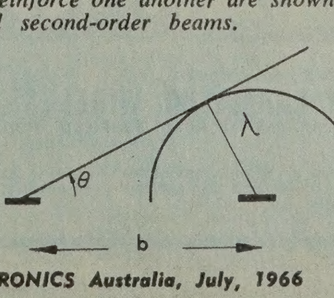
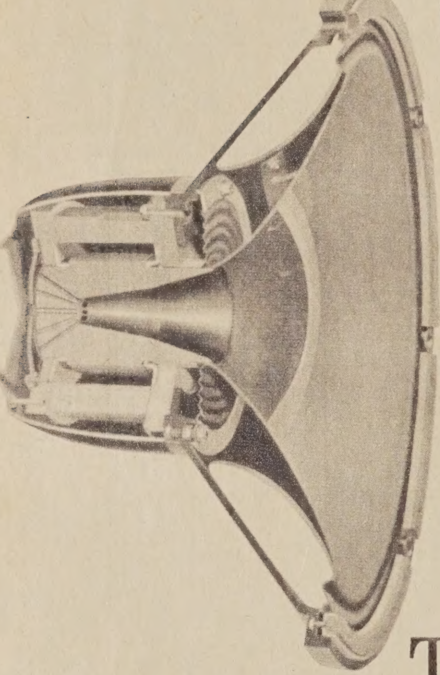


Figure 4: The direction in which the first order diffraction beam travels, as in figure 3, is seen by taking two neighbouring diffraction objects from figure 3.



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the grating of its next door neighbc so that

$$\sin \theta_N = N \lambda / b \; . \; . \; . \; . \; . \; ($$

This resultant reinforced beam called an Nth order diffraction m mum, and the special case of N equ 0, or the ray reflected along the path the incoming beam is called the zerc order diffraction.

When there are very many grat lines, and the spacing b is of the sa order as the wavelength, complica mathematics shows that essentially cc plete annulment of light takes place directions differing from the maxir and measurable light intensities o occur in the directions given by equat 2. The **direction** of the maxima in diffracted beam is also seen from eq tion 2 to depend upon the wavelen of the incoming light, and so differ wavelengths (or different colours) diffracted with maxima in differ directions.

Now we are in a position to see h white light can be spread out by a fraction grating into a series of spect one in each order of diffraction. equation 2 indicates, red light being longer wavelength will be "bent" throu a larger angle than blue light in e order, whereas with a prism the reve is true.

The cover photograph shows a set spectra produced by a diffraction gr ing ruled in the CSIRO Division Chemical Physics at the new Clayt laboratory. We'll discuss some of finer points of this photograph later.

The earliest and relatively crude fraction grating seems to have been p duced by Rittenhouse in 1785, w ruled 53 slits in half an inch. In 18 Fraunhofer ruled 4,000 grooves in h an inch, which was bettered in 18 when Nobert ruled 6,000 grooves in h an inch, but kept the details of process secret.

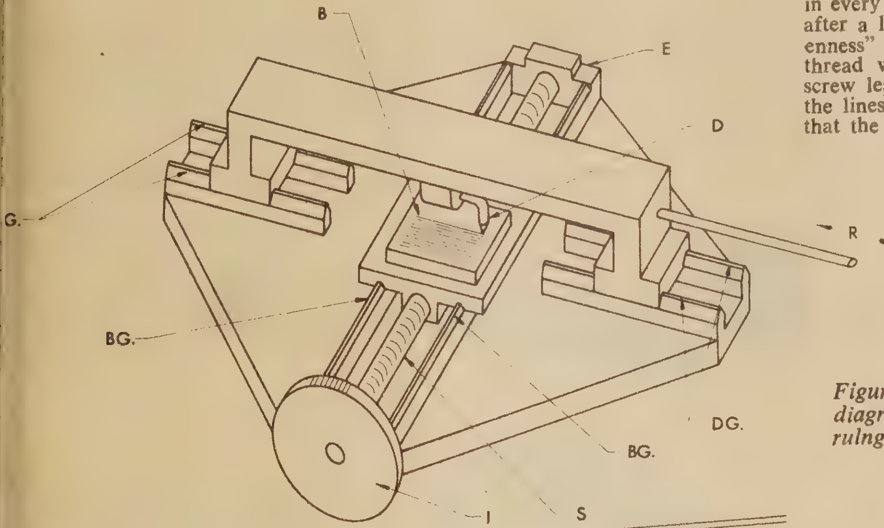
But the first really respectable gr ings, with a performance compara with a prism were made by Rutherf about 1870. Rutherford was an Ame can lawyer interested in astronomy a hobby — there is an observatory Columbia University named after hi He ruled as many as 35,000 grooves two inches, in a mirror of specul metal.

Father of the modern diffracti grating was H. A. Rowland, in Jo Hopkins University in Baltimore w within two years of accepting the ch lenge of grating ruling had produced grating of 6 inches ruled width havi more than 100,000 grooves and a solving power better than a prism.

Rowland made three ruling engi before his death in 1901. In 1904 th were damaged by fire (and one w commentator says that they were da aged even more in the repair proces but they are still in use, having be put in good condition later. Rowla was the father of modern diffracti gratings, and his "ghosts" live on regurgitate an old wisecrack — "Ro land ghosts" being one particular ty of "bug" that turns up due to errors grating ruling to plague their users!)

Rowland's type of ruling "engine" shown in principle very diagrammatic ly in figure 5. Although other m modern machines differ from it, th embody the same general principles a we will use it to describe some of t ficulties and triumphs of grating nufacture.

In barest essentials, it consists of a nk plate B, usually a glass optical flat ated with a thin uniform layer of minium, which a diamond D can ss over to emboss a groove in the minium. The guides DG ensure that e diamond travels in a straight line en it is moved by the reciprocating otion R. The blank B sits on a carge which is on similar guide ways G, which allow the carriage to move ong a line at right angles to the lines uled. A screw S is held at each end n bearings E and an indexing gear heel, I, is attached to it.



After each line is ruled, the diamond s raised from the grating. The gear heel I is rotated precisely the same mall amount for every line, which urns the screw S and, via the nut atched to the carriage, moves it along very small distance, whereupon the ext line can be ruled.

Perhaps you are saying, "What's all e fuss about? That's simple enough." ut is it? It's time to bring out the pecifications and tolerances needed to roduce a good grating.

a) The lines shall all be straight to better than a micro-inch (one millionth of an inch).
b) They shall all be parallel so that the distance between them does not vary by more than 0.3 micro-inches along their length.
c) All grooves up to the last shall be within 0.3 micro-inch of their correct positions with respect to the first groove even though the last groove may have been ruled ten days or so after the first.
d) The grooves embossed by the diamond shall all be of the same shape, width and depth to about one micro-inch. Thus no chatter or vibration of the diamond can be permitted.

These tolerances are about a thousand imes more exacting than those used in oolmaking, and special techniques are nvolved. There are many things to inerfere with the attainment of these specifications. We can only list a few and the means adopted to combat them.

In many scientific instruments the principles of kinematic design are used, which briefly is based on the minimum number of mechanical constraints being used to define a particular position of a component of the instrument. But this may be seriously affected by wear in a ruling engine. After all, a medium-sized grating may require the ruling of 100,000 lines and wear can be considerable, unless precautions are taken.

The design of a modern ruling engine takes wear into account; it tries to render its effects negligible, and to ensure that wear will not result in a significant change in position of one part relative to another.

Exactly the opposite principle is invoked sometimes in ruling engines, that of "elastic over-constraint," or the averaging of position due to a large number of constraints between parts.

First the guide ways, SG in figure 5, must be extremely straight as a slight departure from linearity in the travel of the blank can result in the development of "fanned" lines, as exaggerated in figure 6A. This causes a wider spacing of lines at the top of the fan and narrower spacing at the bottom, which results in a spread of the angle of diffraction of any one wavelength, resulting in loss of resolution. The early workers did not really overcome this one, but the modern machines have disposed of this problem, as guide bars straight and parallel to one micro-inch can be made.

Secondly, the temperature of the ruling engine must be maintained very constant, preferably to about 0.01 deg. C throughout the ruling process, which may take a fortnight! Rowland and the Australian, Grayson, made use of the very great constancy in temperature in the vaults of a large building, just as the wine connoisseur does! Should the temperature change, there will be a gradual increase or decrease in the spacing of lines, again resulting in spreading the angle of diffraction for a given wavelength.

Another source of trouble is the screw. Among the many errors that can occur here are "periodic" errors in the screw, so that the inaccuracy is repeated in every turn of the screw, or is repeated after a larger number of turns. "Drunkenness" or lean of the plane of the thread with respect to the axis of the screw leads to a periodic "bunching" of the lines as in figure 6B. Even the fact that the 1-inch dia. screw sags under its own weight can be an embarrassment! If you think the screw thread a simple thing you should turn to Rowland's article on the screw in the Encyclopaedia Brittanica!

Rowland was the first to satisfactorily overcome the obstacles involved, and his gratings, first produced in 1882, set a very high standard. But an Australian, H. J. Grayson, was next to make valuable contributions to the art.

Figure 5 (Left): A schematic diagram of Rowland's type of rulng engine. An explanation is given in the text.

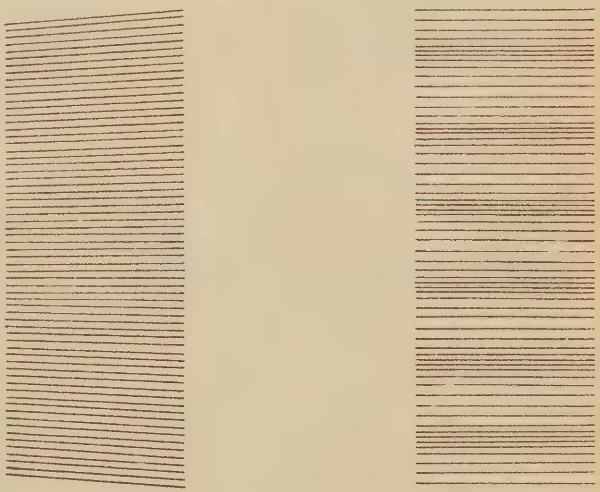


Figure 6: Two types of error in gratings, (left) a "fanned" grating due to curvative in the guide ways BG of figure 5, and (right) periodic bunching of the lines, due to a periodic error in the screw which determines their spacing.

Grayson was an interesting person. He worked in the University of Melbourne at the turn of the century as a gardener in the Botany Department. His skill with tools and practical know-how soon involved him in making various pieces of scientific apparatus for that department and it was a small step, literally, to the Department of Natural Philosophy, right next door, which also needed Grayson's skill as an instrument maker.

He first tried his hand in 1895 at ruling as many as 120,000 lines per inch as test pieces for microscope objectives, using a unique ruling device of ingenious design. Although the rulings

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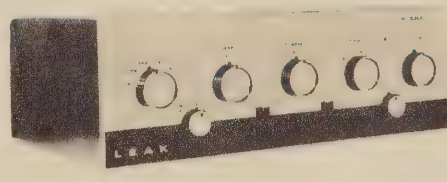

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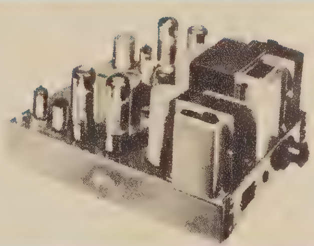

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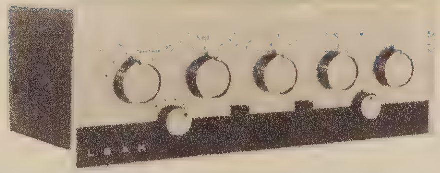

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e closely spaced they did not demand h exacting standards as a grating.

The lure and the challenge of ruling od diffraction gratings soon captivated n, and he built a ruling engine of the re conventional kind. His first efforts re being produced by 1910.

Like most makers of diffraction grat- s, he was discontented with his early orts and struggled to attain better ults. His ruling engine was ultimate- housed in the vaults of the great l of the university, Wilson Hall hich was destroyed by fire in 1952). ere he produced some of the finest tings ever made up to that time, with help of his friend, W. Stone, who s chief engineer of the Victorian Rail- ys Department. The project was ongly supported by Professor T. R. le, who encouraged Grayson and par- ipated in discussions on the design of engine.

Conscious of the frequent failures of electric power supply, and unable to ord a large bank of storage batteries, ayson used a hot-air engine, driven a gas flame, to turn his ruling en- ne, so that, once a ruling had com- enced, it would continue uninterrupted til the end.

After the death of Grayson, Stone mself, being by now thoroughly bitten the bug, turned out gratings on the rayson machine and published a num- er of papers in scientific journals on nprovements on it. One of these, the zero-lead screw," has been employed in number of ruling engines since then. his is essentially a set of annular rooves, looking at a casual glance like screw thread, held in a similar "nut," cting as end bearings for the lead screw.

Later, the Grayson machine was used y Mr Zeus Merfield, a Melbourne in- trument maker, and now it can be ound in the C.S.I.R.O.'s National Stan- ards Laboratory, in the grounds of the Jniversity of Sydney. A photograph of he Grayson engine is shown in figure 7.

In the mid-fifties, C.S.I.R.O. joined he fray and Mr D. Davies, of the Divi- ion of Chemical Physics, began making ratings by the Merton process. The Merton grating, named after its inventor, ir Thomas Merton, was an attempt to implify the procedures in grating rul- ng and consisted in cutting a very fine nd accurate screw thread on the sur- ace of a cylinder.

First, a conventional thread, as accur- te as possible, is cut in a lathe on ne end of a carefully prepared metal ylinder. Then a special nut is placed n this thread to which a diamond stylus s attached so that, when the cylinder is rotated, the diamond cuts a thread on the other end of the cylinder as in figure 8.

The special Merton nut has three pads of cork or pith, which press on many threads of the conventional screw thread, and fix the position of the nut as an average of the position of the many threads against which they bear. Thus many of the errors in cutting the first thread are averaged out and the diamond cuts a very much better thread.

The cylindrical thread is turned into a plane grating by coating it with plastic. The plastic is then cut parallel to the axis of cylinder and "unwrapped" from the cylinder so that we now have a thin film of plastic with the imprint of the cylinder threads on it. The plastic film is used to transfer the imprint to an optical flat with a film of gelatine on it.

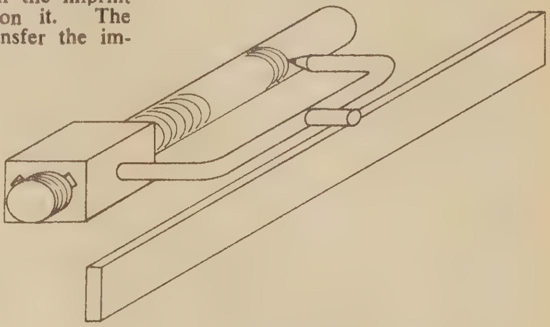


Figure 8 (right): Cutting a diffraction grating by the Merton process.

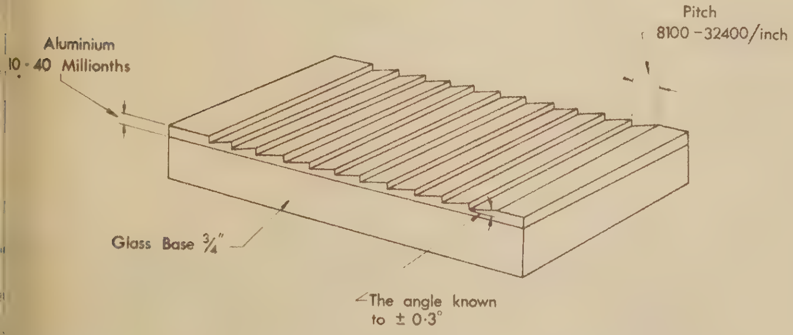


Figure 9 (left): The "blaze" or shape of the ruled line of a grating determines the order of the diffraction spectrum which will contain the most intensity. About 70% of the light can be channelled into one chosen order by proper control of line profile.

Unfortunately, this very ingenious process does not result in the best gratings, mainly due to difficulties in "unwrapping" the plastic and placing it on the glass flat without distortion. The gratings produced, however, are suitable for infra-red use, as here the ruling errors are not so important. A number of these gratings was produced at Fishermen's Bend. In the course of this work, Mr Davies developed methods, now patented by C.S.I.R.O., of producing super parallel metal cylinders by lapping, with diameters constant to better than one-millionth of an inch and sides straight and parallel to the same tolerance.

Mr Davies and his colleague, Mr G. Stiff, then turned to conventional grating ruling and added their own ingenious improvements. They commenced construction of a 7in capacity engine in March, 1958. This machine has been producing high-quality gratings since January, 1960.

One important contribution has been in the region of the diamond. By properly shaping the diamond's cutting edge, the shape of the grooves in the grating can be controlled much better. The cutting edge is made to represent a miniature version of the cutting edge of a battleaxe, i.e. the intersection of two conical surfaces. This is done by polishing the diamond on a metal lap impregnated with diamond dust on an automatic machine, which eliminates the vibrations of normal bearings by using bearings "lubricated" by compressed air.

The shape of the groove embossed in the aluminium coating on the glass plate is not exactly the same as that of the diamond, as the aluminium is plastic and "flows" under the diamond.

But the greatest importance attaches to the mechanical design of the machine. Lapping of components reduces errors to the order of three micro inches. Features designed into the machine cancel or reduce the remaining errors. For instance, it is possible to arrange for a bent screw which sags badly under its own weight (as much as 1 x 10^{-4} in) and which is mounted on eccentric bearings, to advance the blank by steps free of error. Gears can be used so that their errors do not appear in the ruling.

By the use of suitable design and materials, wear can be slow and uniform so that components continue to give precise guidance, e.g., in the C.S.I.R.O. engine there has been no measurable error in groove straightness (five-tenths of a micro-inch is detectable), after approximately 17 million strokes of the ruling carriage! The screw thread was lapped for no less than five months to reduce its errors to less than one micro-inch.

The point of controlling the groove shape, or "blaze," shown in figure 9, of the grating is that this determines the intensity of the light diffracted in different directions.

The ideal is to put out all of the diffracted light in one order of diffraction, so that none is wasted in unwanted orders. In practice, the gratings produced by the C.S.I.R.O. give out about 70 per cent of their total diffracted light in the required order, usually the first or the second. As the cover photograph shows, the first order spectrum, on the left of the zero-order, is the most intense for that particular grating.

The groove shape required is a kind

(Continued on Page 14)

of factory roof sawtooth, the exact angles being very closely controlled. The C.S.I.R.O. scientists also found that the pressure exerted by the diamond and the ruling speed were critical factors in controlling the "blaze." Figure 10 shows the Davies-Stiff ruling engine.

Another big break-through has been in the field of "replication." Virtually no parent gratings are used in instruments these days, but replicas are made of them by methods somewhat similar to those used for Merton gratings.

It has been found that a "sandwich" can be made of a specially prepared grating, a "filling" of liquid epoxy plastic and another glass plate. When the plastic hardens, the glass plate can be stripped off, retaining on its surface a perfect impression of the grating. It is then aluminised and becomes a grating.

Formerly, this resulted in a somewhat lower-quality grating than the parent, but using methods patented by C.S.I.R.O. it is now possible to make at least fifth-generation replicas. That is, a replica is made from the parent and then another is made successively from each preceding replica out to the fifth generation, which are of a quality indistinguishable from the original parent.

This process can be repeated about 50 times with any parent grating. With such a process available, it is possible to choose only the best gratings as parents for subsequent replicas. As a good diffraction grating may be worth $200 to $2,000, a good master may be worth $100,000 or about $1 per line!

The fact that the division had the Davies-Stiff engine available enabled another member of the division's staff, Mr J. J. McNeill, to design a grating monochromator to the specific requirements of the technique of atomic absorption spectroscopy, another of the division's innovations. (See ELECTRONICS Australia," May, 1966.)

This monochromator, which has excellent performance characteristics and is substantially independent of environmental interference, is relatively simple to manufacture. It forms the basis of integrated atomic absorption equipment which is made by an Australian firm under licence to C.S.I.R.O. The apparatus sells well overseas, so that 60 per cent of the firm's output is exported.

Gratings incorporated in the atomic absorption equipment are all checked for conformity with a standard which is the equal of any comparable commercially available grating in the world. It would be fair to say that no gratings produced on ruling engines with purely mechanical control would be as good as those ruled on the Davies-Stiff engine.

In the past decade, a new technique in grating ruling has been introduced by Professor George Harrison, of the Massachusetts Institute of Technology. Harrison has used optical interferometers to control the movement of the carriage on which the grating blank is mounted; the linear advance of the carriage as well as its "pitch" and "yaw" are measured by the interferometers and controlled by suitable servo mechanisms. In this way, the residual mechanical errors in the engine can be reduced.

It is proposed to add this refinement to the Davies-Stiff engine, to produce large gratings of a quality at least as good as anything achieved anywhere.

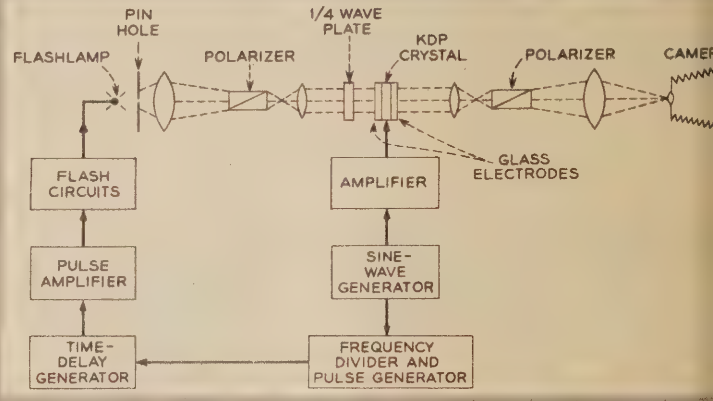
I am grateful to my colleagues, Mr J. J. McNeill, Mr G. Stiff, Mr G. Bell and Mr F. Lugton for supplying information and photographs.

PHOTOGRAPHING ACOUSTIC STRAIN PATTERNS

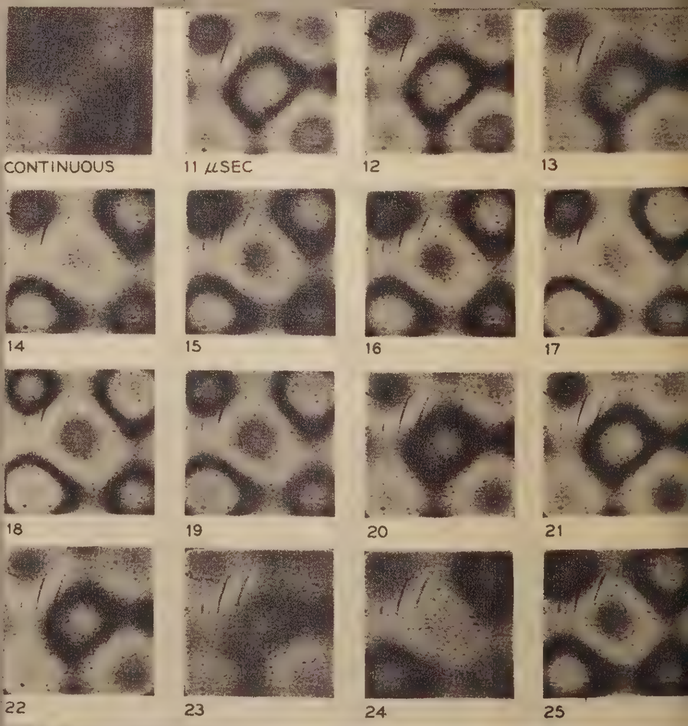
Scientists can now actually see how a crystal changes at
moment as a sound wave passes through it or when it is made to o
late at high frequencies. Dr G. E. Paterson and Mr P. M. Bridenba
of Bell Telephone Laboratories have devised a way of observing
instantaneous strain in the transparent piezoelectric crystal, potass
dihydrogen phosphate (KDP). The KDP crystal was sandwiched
tween two glass electrodes. While the crystal was vibrating, burst
polarised light, synchronised with the acoustic vibrations, were dire
through the crystal and focused on to a camera.

This technique provides an almost continuous picture of the crys
acoustic strain at intervals as short as a fraction of a microsec
Previous methods of observing acoustic strain, such as sprinkling pov
on the crystal surface or using X-ray diffraction, did not provide
time-resolved patterns or the detail now possible.

The new technique is useful in the visual analysis of instantan
strain in transparent material, and can help in developing impr
transducers, filters and frequency control devices. The time-reso
acoustic method may also help in understanding the scattering of
acoustic beam as it moves through a crystal.



Schematic diagram of the set-up used in the experiments.



These photographs, taken at intervals of one microsecond, show how the structure of a crystal changed when it was made to oscillate by an ultrasonic sound wave of 100KC frequency.

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THE NEW DECCA-KELLY KARDIOID ENCLOSURE

Recently the all new Decca-Kelly Kardioid speaker enclosure was released in the United Kingdom. Featuring a new Model DK1 12in bass unit with a Kelly Mk. II Ribbon Tweeter, the Acoustic Lens is also incorporated to improve HF dispersion. The upper limits of sound reproduction of the new enclosure are in the 35 Kc/s region. Cabinets are in hand finished teak. Write for specifications and prices.

KEF SPEAKERS

The new KEF "Celeste" with the improved "Super-tweeter" is now in stock. HF performance is considerably improved with this new tweeter.

Write for an EMQ or call at your nearest Encel Stereo Centre for a demonstration.

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Encel Electronics' Sydney store is now open . . . conveniently situated on the Ground Floor 2SM Building, 257 Clarence Street. (Tel. No.: 29-5160). Here is a veritable Aladdin's Cave of audio equipment, tape recorders, etc. . . . including many exclusive Encel lines not available elsewhere in Sydney.

TOP VALUE COMPLETE STEREO SYSTEM

PLANET — MG1504 stereo amplifier. Labcraft 643 turntable with B and O magnetic stereo diamond cartridge, two Wharfedale 8in RS/DD wide range speakers. **$128.00.**

FILM INDUSTRIES MICROPHONES

Encel Electronics Pty. Ltd., has been appointed Australian Distributors of Film Industries microphones. These well known products are supplied as standard equipment with high quality recorders such as Vortexion and Ferrograph. A complete range will soon be available to the Australian recording enthusiast. The type M8 Ribbon microphone has a frequency response of 35-13,000 c/s plus or minus 3 db . . . a recent review says . . . "The Film Industries M8a ribbon microphone has a most attractive appearance coupled with a performance, which, in many respects, can stand comparison with the best designs at three or four times its price." Write to us now for details and an EMQ.

FISHER AMPLIFIERS

A complete range of Fisher amplifiers is available. Write for EMQ's (Encel Mail Quotes) or trade-in valuations on your old eqiupment.

TAPE DECKS

The Grundig TM 45 deck (as used in the TK46 recorder which sells for **$480**) is now selling at **$171.** Normal retail is **$241.50.** Also in stock — Sony TC250a and Collaro. Write for EMQ's.

UNIQUE ENCEL STEREO SYSTEM WITH 5
SPEAKER ENCLOSURES

If you wish to purchase a complete stereo system at budget rates, this outstanding offer must interest you. Included are the Star SA30 stereo amplifier—10 watts RMS each channel, Labcraft 643 turntable with B and O stereo diamond magnetic cartridge, two "Sonics" 5 speaker systems with oiled walnut or teak cabinets. Each system employs four 6½in speakers, and one 2½in tweeter **$195.** (The new Encel CSM-40 stereo amplifier may be used with this unit . . . if you prefer it, add **$26.**)

ACOUSTECH AMPLIFIERS

Encel Electronics has been appointed Australian Distributor of these famous American amplifiers. Many leading reviewers use Acoustech equipment for personal listening . . . and the new solid state Acoustech units are outstanding. The first shipment sold out quickly — please write for prices and specifications — or call at either Sydney or Melbourne Encel Stereo Centres.

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A wide range of photographic equipment — cameras, projectors, etc. — is now in stock. Leading manufacturers from the Continent and Japan are represented — most popular makes are available. All equipment is BRAND NEW and guaranteed. Ask for quotes on the photographic equipment you need. Sorry — we cannot give telephone quotations — trade associations frown on this practice.

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Although our range of tape recorders is extremely wide, Encel prices are wider still — starting at **$37.** Advertising prices is forbidden by trade associations — but Encel Electronics sales are at an all time high! Stock now includes: Revox G36, two and four track — Tandberg 64 and 74B — Beo-Cord 2000 and 1500 — Akai M8, X4, 355, 1700 — Sony 500a, 200, 357/4, etc. — National 703S, 705, 755S, etc. — All Philips new models — Ferguson — Truvox — Grundig — and many more. You'll save more at Encel Electronics!

ROLAND FAX 150 STEREO AMPLIFIER

This popular stereo amplifier incorporates a built-in AM and FM Multiplex. Write for an EMQ and specifications.

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Nikka, Micro, All-Balance, Ortofon, J.H., Pritchard, etc.

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MICRO TONE ARMS AND CARTRIDGES

Encel Electronics now stock MICRO arms, Model MA-77 and the Micro M-1007 magnetic and SC-301 ceramic cartridges. Write for prices and specifications.

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1. Leak Stereo 30 amplifier, Orpheus Silex turntable. ADC-40 tone arm, ADC-4E cartridge, two Celestion CX 2012 co-axial speakers Price **$438**
2. Pioneer SMB-161 stereophonic amplifier with AM/AM/SW tuners, Labcraft 643 turntable with B and O stereo diamond magnetic cartridge, two Wharfedale 8in RS/DD speakers. Price **$199**
3. Sansui Stereophonic amplifier with AM/-FM/SW tuners, Orpheus Silex turntable. Ortofon SMG 212 tone arm, Ortofon SPU-GT-E cartridge, two Celestion CX1512 speakers. Price **$355**
4. The new Encel X1212 or the Star SA30 stereo amplifier, Labcraft 605 turntable, J.H. tone arm, ADC 770 stereo diamond magnetic cartridge, two twin-cone 10in Wharfedale RS/DD speakers. (10in Richard Allen speakers at the same price. (With the new Encel CSM-40 stereo amplifier. Price **$212.** **$187**
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* Make up your own combinations and ask for an EMQ!

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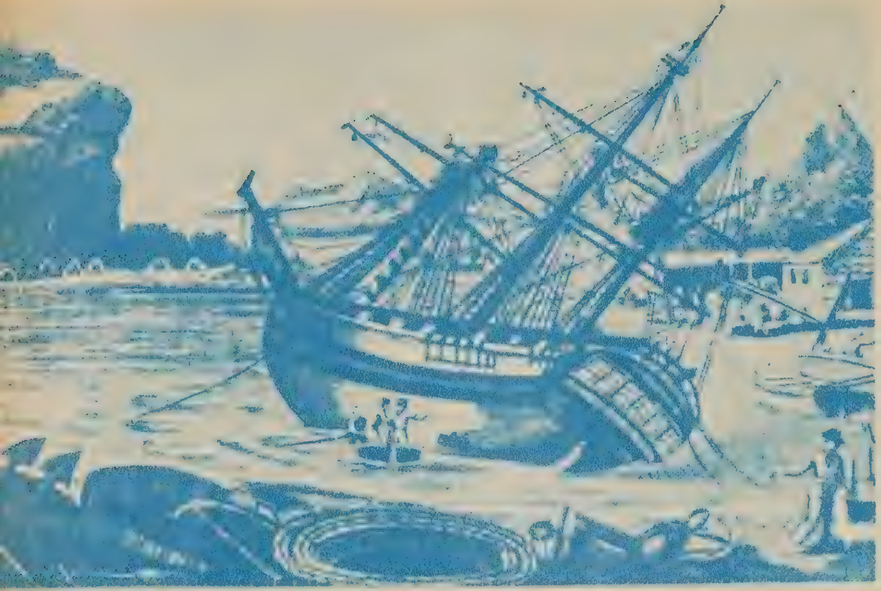


The Endeavour careened b side the Endeavour River, aft being holed on the Barrier Ree This mishap forced Cook jettison six cannon, which st lie on the seabed.

Magnetometers Find Many Thing

By BRIAN LENON* and BILL BAVERSTOCK

At first glance there would appear to be little connection between Captain Cook's ship Endeavour and the modern magnetometer. But there is a link. As well as locating mineral and oil deposits, or detecting foreign objects in food cans, this versatile electronic device may well have pinpointed valuable historic relics on Australia's Great Barrier Reef, where the Endeavour ran aground.

Author-navigator Alan Villiers is strenuously rejecting any suggestion that he use modern navigation methods aboard the replica of H.M.S. Endeavour when he sails from Britain in 1970.

But, behind the scenes, an electronics instrument may play an important part in the venture. It has been used to pinpoint the location of a metal mass on the Endeavour Reef, where Captain Cook dumped six cannon guns to lighten the original Endeavour when she grounded on the coral on June 11, 1770.

Equipped with an airborne magnetometer, a plane flown by Aero Service Limited, of Ramsgate, New South Wales, last year made a survey of the waters of the north Queensland coast. Aero Service Limited, a division of Litton Industries, California, was performing a Shoran controlled airborne magnetometer survey over part of the Barrier Reef for an international oil company with the aim of ascertaining whether the shallow waters and reefs conceal reservoirs of oil. By-products of the survey are the first modern charts of large sections of the Barrier Reef channels which have been little defined since Matthew Flinders charted them 160 years ago.

Litton became interested in the search when one of the Aero Service Limited executives from Philadelphia, who was holidaying on the reef, heard from an old skipper the story of Cook's historic guns lying somewhere among the coral. It was realised that Aero Service Limited, because of its work in aerial oil and mineral exploration, also had the capability to find hidden metal objects and they were urged to pursue the search as a sort of Litton goodwill gesture to Australia.

The survey aircraft, flying at 50ft above the water, recorded a distinct anomaly at a position approximating that given by Captain Cook in his journal as the spot where the Endeavour was grounded. The intensity and other characteristics of the anomaly suggested that they could have been caused by a mass of metal approximately 20 tons in weight, while mathematical calculations based on average specific gravity for iron and brass indicated the volume of metal to be in the vicinity of cubic feet.

It could also be assumed that, in process of dropping the mat overboard and in subsequent action, the body would approach of a horizontal slab. The approxi dimensions of the slab would be in order of 2ft thick with horizo dimensions of 5ft and 10ft. This is a very diagnostic feature, however, there would probably be a consider amount of remnant magnetism in iron. The anomaly produced c attain just about any shape as a r of these remnants and would be a poor indicator of body shape.

The anomaly obtained at 50ft cates only about five gammas amplit This corresponds to a susceptibility, a mass of the type described above 715 x 10^{-6} cgs units. This is n particularly appropriate susceptibility pure iron, but there is no reason suspect that the cannon were origi pure iron nor is there any reason doubt that they would be highly weat ed and largely altered to oxide (magnetic haemitite).

Plans are now under way for divers to examine the metal mass if, as seems almost certain, it is Co guns, they will be brought to the face and later mounted in the re of the Endeavour.

The dramatic implications of search for Cook's guns has directed attention to the magnetometer—the sitive instrument that assists in the se for oil strata and mineral deposits the air.

Airborne, the magnetometer greatly broadened the scope of physical exploration. In the pas years, it has helped man speed the of exploring the earth's surface for dence of minerals and oil deposits. mineral concentrations are comm associated with magnetic materials significent distortions of the earth's netic field can identify much of mineral wealth of the world. These tortions are measurable not only o ground, but thousands of feet abov Thus, the development of the mag meter opened the way to exploratio a scale previously undreamed of.

A magnetometer measures strength or intensity of the earth's netic field in a specified direction. cal and horizontal magnetometers often used on the ground, but airb magnetometers usually measure the nsity, i.e. the intensity in the direc- of the total field. The unit of in- ity used is the gamma (a force of dyne is exerted on a unit magnetic in a field of 100,000 gammas).

---

*Vice-President, Aero Service Ltd., Ramsgate, N.S.W.

he earth's magnetic field changes n place to place and these changes be traced to two main causes. The nary cause is that the earth's mag- c field is roughly that of a dipole h its axis joining the North and th Poles. This main field changes n about 60,000 gammas in a verti- direction at the poles to about half intensity in a horizontal direction the Equator.

t acts on magnetic materials in the h's crust, inducing a secondary field them so that they act as magnets nted in the same direction as the n field. Since rocks probably lose ir ferromagnetic properties at a depth about 13 miles, where the tempera- rises above the Curie point, the ondary field comes from a limited ume of material and does not nor- lly exceed a few thousand gamma size.

or magnetic surveying, the critical nt is that the primary field varies tively slowly from place to place ile the secondary field varies rapidly e the magnetometer is much closer its sources. Thus the magnetometer plies information on the distribution magnetic minerals in the earth's st.

y far the most important magnetic eral is magnetite. This occurs as an essory mineral in igneous and meta- rphic rocks and usually basic rocks tain more magnetite than acidic ks. Sediments, with the exception iron formations, are relatively non- gnetic. This property of rocks to ome magnetised by an external field described as their susceptibility. Other ngs being equal, the anomaly pro- ed by a body is directly propor- nal to the susceptibility and to the ength of the inducing field.

ocks have a wide range of magnetic ceptibilities, and, in round numbers, y from about 100 x 10^{-6} cgs units granite rocks up to 1,000 x 10^{-6}, even 10,000 x 10^{-6} for basic rocks. en the rocks were formed or meta- rphosed, they may have become per- nently magnetised. The induced mag- ism is added to this remnant mag- ism; the two are not necessarily in same direction nor of equivalent in- sities.

An increasing degree of attention is w being devoted to permanent mag- ism, particularly in dealing with vol- ic and intrusive rocks, where it may strong in a direction markedly dif- ent from the particular magnetic field the earth.

These facts lead to the conclusion t the magnetometer can give inform- on about the basement rocks, intru- es or lava flows but does not usually e any direction information about the liments.

Whilst many methods of geophysical loration cannot be applied from an craft, the airborne magnetometer is npletely free from such limitations. can pick up significant signals that s through thousands of feet of rock, ndreds of feet of water and thousands feet of air.

These regional irregularities, caused magnetic variations in the shape and nposition of the earth's mantle and per crusts and disturbances due to concentrations of magnetic material close to the surface, are what the aerial surveyor seeks and the magnetometer is the exploration tool.

This instrument has been used in oil and mineral aerial exploration for the past 15 years. Though sensitive and accurate magnetometers have existed for longer than this, they were unsuited for aerial use. In the 1930s, an electro-magnetic circuit, known as the Fluxgate, was adapted to the accurate measurement of magnetic fields.

The Fluxgate was improved shortly after and a method developed for stabilising it against the motions of an aircraft. Its uses in naval warfare were obvious and it became a major instrument in the detection of enemy submarines. Peacetime modifications produced an instrument which has had dramatic success in airborne geophysical surveys leading to the development of hitherto undiscovered mineral fields.

Scale model of an Endeavour cannon. Constructed by Mr C. L. Hulme, of Sydney.

The Fluxgate is the sensing element of the magnetometer and consists of a pair of parallel coils arranged to produce voltage when they are placed over a magnetic field that has a component along their axis. Present versions are sensitive to variations of .5 gamma.

Another type of magnetometer is based on the principle of nuclear precession.

A coil of wire is wound around a bottle of water or other liquid containing hydrogen nuclei. These protons act as spinning magnets. A current passing through the coil produces a strong magnetic field which polarises the nuclei bringing them into line with the applied field. The current is suddenly cut off and the nuclei at once begin to return to their previous orientation.

In fact, they precess or spiral about the earth's magnetic field and the frequency of precession is directly proportional to the intensity of the field. By measuring this frequency, an absolute measurement of the field is obtained; no orientation mechanism is required except that the polarising field must not be parallel to the earth's field and this is not difficult to arrange.

Both types of magnetometers — the proton and Fluxgate—produce records of about the same accuracy. Since magnetic prospecting is concerned with changes of the magnetic field, the fact that the proton magnetometer measures the absolute value of the field is of little importance.

Recent research into magnetometers has produced such exciting new instruments as the Rubidium Vapour Magnetometer, Metastable Helium Magnetometer, and Cesium Vapour Magnetometer.

Such instruments are capable of measuring anomalies in the 100th of a gamma range. Successfully developed for airborne surveys, they can allow much more precise interpretation of weak anomalies. There are indications that some sedimentary structures produce magnetic anomalies large enough for these magnetometers to detect. If this proves true, the airborne magnetometer will gain new fields of application.

At the heart of the Fluxgate Magnetometer is a pair of parallel cores with high magnetic permeability. Each is wound with a coil which drives it cyclically to saturation. As the core becomes saturated, the inductance of the coil is sharply reduced, causing a sharp drop in the counter e.m.f. across the coil.

The coils are connected in series opposition and, if they were identical, there would be no difference in their counter e.m.f.s.

However, the current flowing through one of them is slightly reduced by a shunting resistor so that its core will be saturated slightly later than the other. The sharp drops in counter e.m.f. will occur at slightly different times and the difference between them will produce a

One of the aircraft used by Aero Service Ltd., in the search for Captain Cook's cannon. Note the "stinger" extending from the tail, and which houses the magnetometer sensing element.

Magnetometers—Continued

series of pulses, one during each half cycle.

This argument is correct if there were no external magnetic field.

The earth's magnetic field will aid the magnetisation on one core on one-half cycle making saturation occur earlier and will oppose it on the next half cycle, delaying saturation.

Furthermore, since the coils are oppositely wound, when the earth's field is making saturation occur earlier in one coil, it is delaying saturation in the other. So, on one half cycle, the pulses are brought closer together in time and, on the other, they are further separated. Thus the pulses are no longer balanced.

By means of a compensating coil, the pulses are continuously balanced and the current flowing through this compensating coil measures the earth's magnetic field.

The measuring element of the magnetometer is automatically aligned in the direction of the earth's field by two similar elements mounted so that all three are mutually perpendicular. These two elements orient the platform by means of servo-mechanical mechanisms which keep them in the position of zero magnetic field.

Early magnetometers were simply towed about 100-150 feet behind an aircraft in a torpedo-shaped bird, but modern installations are housed in a "Stinger" behind the plane's tail. Any interference caused by generated currents or aircraft's manoeuvres are compensated by strategically placed bar magnets.

The surface of the ocean is never still. It moves up and down with the tides and waves; likewise the earth's magnetic field is always fluctuating.

A magnetometer cannot measure the difference in the intensity of the field from place to place without measuring also the change in intensity which has occurred when it was moved between the two places. In making accurate magnetic surveys, the effects of these time variations on the field must be removed.

This is particularly important in oil exploration since the time variations of the magnetic field can amount to tens of gammas in a few minutes. The changes from day to day or over a longer period are easily dealt with by repeating observations of the same place, but variations which occur in a few seconds, minutes or hours, are not so easily overcome.

In the jargon of magnetic surveying, these variations are called "diurnal." These are caused by varying electric currents flowing high in the sky or within the earth itself. To make accurate magnetic surveys in the most economical way, the problem of removing the effects of time variations of the magnetic fields must be faced.

In ground magnetic surveys, a base station magnetometer often is used to record the variations which are applied as corrections to the field stations. Observations are also repeated at various stations in the field.

In airborne magnetic work, where the survey area is often more than 100 miles from the base, the variations are usually removed by flying control lines across the traverses. The lines can then be levelled together and the instrument drift will also be removed in the process. A ground magnetometer is operated at the base to ensure that no flying is done in magnetically disturbed periods.

Essentially, there are two raw products from an airborne magnetometer survey: The magnetometer record in the form of continuous profile, and some record of the flight path, usually a 35mm film. These records are keyed together by numbered fiducial marks, which have been simultaneously added to them.

Once the flight path has been established on the map, the magnetic information is then transcribed onto the flight path by the fiducial correlation and the resultant map is presented as contours of total magnetic intensity.

A magnetic map or profile is in itself of no value for exploration. It becomes useful only when it has been interpreted and used to discover geological structure. In the case of the survey over the Endeavour Reef, the locations of recorded anomalies were pinpointed on aerial photography of the reefs and then mathematical and physical evaluation began.

In the course of many profiles flown over the Endeavour Reefs, a significant anomaly was recorded at an altitude of 50ft. This anomaly was subsequently repeated on many flight lines flown in different directions over the same point. To complete the survey and eliminate the possibility of coincidence on this particular anomaly, the flight lines were extended to include the southern edges of the reef to cover the area alleged to be where the Endeavour ran aground. No significant anomalies were recorded.

Flying was then concentrated back to the original anomaly and an additional series of tests were flown, consisting of varying flight directions and altitudes.

It was found that, by lifting the aircraft to 100ft above water, the anor
almost disappeared on the magneton
record. Again, at 50ft altitude, mis
the feature under the water by 50ft
ectionally caused the anomaly to al
disappear from the magnetometer rec

These tests show that whatever is
ducing this anomaly recorded by
magnetometer is very localised and
fined to a small area. Subsequent
of the Fluxgate magnetometer in a
confirmed the existence of a local
anomaly over the area indicated by
airborne magnetometer record. P
as to the existence of such a mass u
water, giving rise to such localised
malies, can only be ascertained by s
divers.

The sensitivity of a ground magn
meter was illustrated dramatically i
United States cannery recently when
employee noticed that a cog in the p
had broken a tooth. The tooth c
not be found and it was thought it
have dropped into one of the cans
fore sealing.

The firm's reputation was too g
to take a risk; better to scrap the w
batch at a loss of several thousands
dollars than to send out one defec
can.

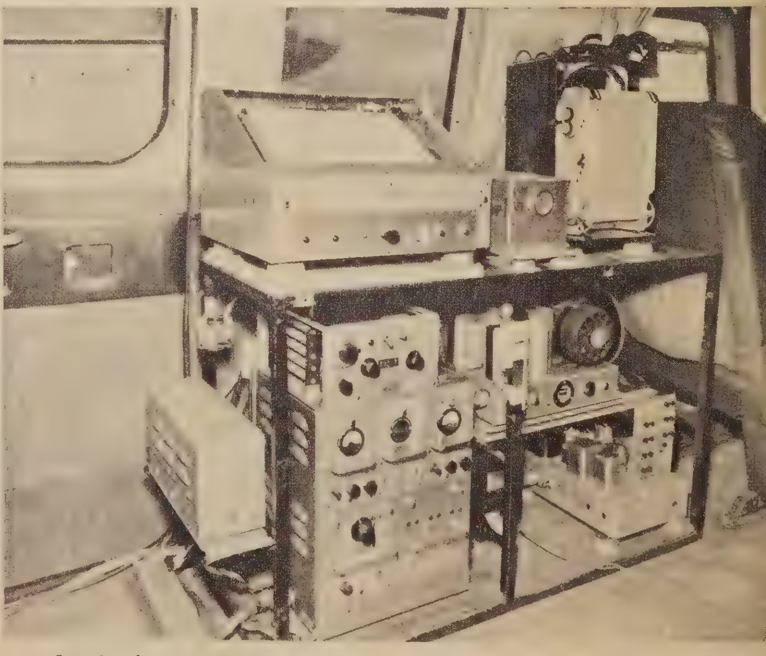
Just before giving the order to sc
an executive of the canning comp
had a chance conversation with a t
nician from Aero Service Corporat
The technician said that it may be
sible to locate the can with the bro
tooth. He offered to try.

He set up a magnetometer geared
a reading for normal cans of food
the whole batch was passed under
Only three cans, among many th
sands, caused a fluctuation in the r
ing and these were picked out and o
ed. One proved to contain a split
the second a hairpin, and in the t
was the missing tooth.

References:

(a) Airborne magnetometer surveys
Petroleum Exploration by M. S. Ref
1964.

(b) "The Airborne Magnetometer,"
Homer Jensen, 1961.



Inside the aircraft, showing the magnetometer used in the search.

Now available in Australia!
X1512
CX2012

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le unwittingly we've done the wrong thing . for some time Encel Electronics has been ng the popular LUX SQ11 stereo amplifier acceptance in Australia has been gratify- But due to difficulties in communication, ly other LUX units have not been available Australia. Until Mr Alex Encel was in- ting the LUX plant recently we were un- re of the existence of a vast range of nically advanced LUX equipment. LUX lifiers were used in the Olympic Stadium at yo (the sound was magnificent) and LUX lifiers are used by the NHK Broadcasting work. Soon, a new **silicon transistor** stereo lifier from LUX will be in Encel Stereo tres . . . it has a peak power output of watts (total) and input sensitivities as low 1.8 mV. Magnetic pick-up sens. is 3.5 mV. new type of tone control enables variable uency crossover in both treble and bass; ry useful and desirable feature has been in- porated. Delivery is only a few weeks away Encel price will be **under $190** (£95). Other X models will follow this new LUX product.

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Regarded as one of the most advanced compact speaker systems ever to be released, the Celestion Ditton 10 is available in either teak or walnut oiled finishes. Frequency response is conservatively quoted at 35-15,000 c/s. See the reviews in "Hi-Fi News," p. 433, Oct., 65; and "Gramophone," p. 41, June, 65. Size of the Ditton is only 12¾in x 6¾in x 8¼in.

Encel price . .. . **$59.**

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Australian Team Sees The Job Through

Working under unbelievably difficult conditions, using their initiative to overcome myriad problems caused by lack of equipment and living in a war zone, a team of S.T.C. technicians has returned to Australia after establishing a vital communications base in Vietnam.

The new radio station is as powerful such Australian national stations 2FC in Sydney and radiates infor-ation and programs throughout the ighlands areas of South Vietnam and ito neighbouring countries.

It is a gift in aid under the Colombo lan by the Australian Government to ie Government of South Vietnam and ill be used extensively as a weapon combat Communist propaganda.

The 55KW radio transmitter, the 20ft-high radio transmission mast, the irge ancillary power plant and other quipment was installed near a highlands rovincial town named Ban Me Thuot, 60 miles north-east of Saigon. It was lanned that the majority of the work ould be carried out by Vietnamese chnicians with guidance and supervision to be provided by the Australian am.

However, this proved to be largely npracticable and the project developed irtually into a "do-it-yourself" job for ie Australians.

In all, 12 Australians worked on the ob, but the S.T.C. project engineer only as there for the full term. S.T.C., as rime contractors, also provided a chief adio technician and a foreman, and ustralian sub-contractors provided experts for erection of the mast and the ower plant. A senior P.M.G. engineer ined the team in the final stages to upervise testing for the Commonwealth.

Constant protection was given by the ietnamese Army, and the American ilitary detachments in the area added onsiderably to keeping an eye on the am's welfare.

The station site, which was considerd as being on the fringe of secure rritory during daylight hours, and the oad to it, were specially guarded as rotection against Communist guerillas, s well as insurgent elements who had mbitions for freeing the highlands from ietnamese authority to become an utonomous zone for Mountagnards — cal indigenous tribes peoples.

It may seem something of a paradox hat the guard of up to eight men, rmed to the teeth with automatic weapons, carbines, grenades, knives and hat-have-you and who "lived-in" with he Australians at their team house, ere Mountagnards, but this is only one wist of the confusing situation in this ountry.

It was not the danger zone, however, hich troubled the Australian installaon team, but rather the lack of local quipment, the shortage of esential aterials and the great difficulties of ansportation from the coast, which ampered their work. This, together ith severe, unseasonable rain, which uined much of the equipment shipped from Australia, caused untold headaches for the chief project engineer for Standard Telephones and Cables Pty. Limited, Mr Rex Giles.

Mr Giles gave a graphic description of the hazards and frustrations of the project.

"Transportation of the very large mast components was one of the typical problems and this had earned the project the reputation for being difficult before we reached Vietnam. There were troubles in trans-shipping it at Singapore, which left doubts whether all items had reached Saigon, but fears on this account were overshadowed by the problems of moving it from Saigon to Ban Me Thuot.

"Air transport was the only means that could be considered 'V.C.-proof' and many tons of the radio equipment had already been sent forward by U.S. military craft. However, aircraft large enough for the mast parts simply were not available, so it was decided to rail transport this gear 230 miles up the coast and then carry it about 100 miles by protected convoys over the mountains to the site.

"When I reached Saigon, nobody had a really clear picture of just how this plan had worked out, and it was not unlikely that it was scattered along the route — not to mention the possibility of some of it being at the bottom of Singapore Harbour.

"We were lucky though. Most of it had reached Ban Me Thuot, and the main remaining worry was a batch that had been stranded along the route by the disastrous floods that coincided with the movement. The particular area had since been taken over by the V.C., so the gear was apparently to be written off as lost. However, the situation eased after a while and it was a happy day when five trucks rattled in with the gear more or less intact."

The site for the radio station had been cleared only 12 months previously, but it was found to have become covered again with chest-high grass and brambles up to 12ft. Getting a bulldozer for clearing this, plus a truck and a mobile crane for moving the heavy steel work into position, all posed difficulties. Giles says there was nearly always a missing link—a bulldozer, but no driver —a truck but no crane—any combination but no fuel or engine oil.

However, the local Vietnamese authorities tried hard to clear the obstacles and American military people were extremely generous in bridging difficulties despite their limited resources in the area at that time. Naturally all these hitches caused loss of precious time in the race to get "outside" work at least through the vital stages before the wet season started.

The 620ft high mast with its 70ft diameter umbrella top.

For such a high mast, a large amount of concrete work was necessary for the main foundation and the 12 guy anchors —the largest block required 15 cubic metres—and of course each of these blocks had to be poured as a single operation in one day—and in daylight, while the V.C. were under cover. This meant that a large capacity concrete mixer was necessary, but this was beyond the resources of Ban Me Thuot— thus Giles started a search up and down the country to find one.

"I found one large enough in Pleiku, about 100 miles away, and after a deal of negotiations, persuaded the military owners to let me move it to Ban Me Thuot. I felt pretty pleased when I got it to the local airstrip and stripped it down so that it could be just squeezed into the largest aircraft to be had—one of which was promised for next morning.

"That night the V.C. made major attacks on the airstrip and another military establishment on the opposite side

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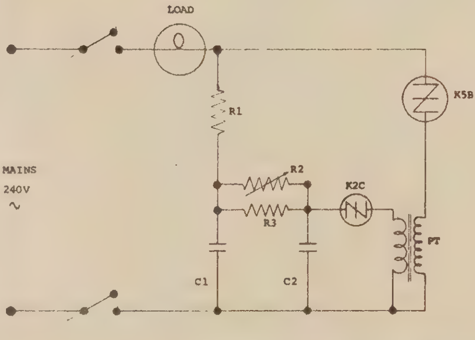

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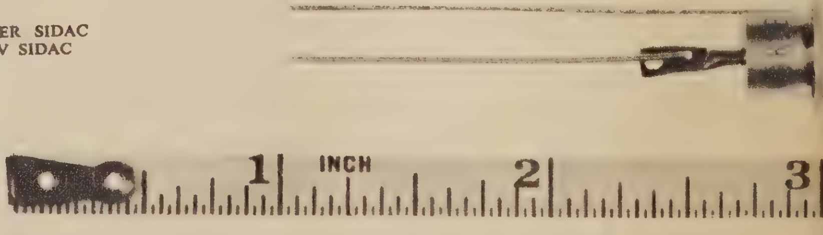

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the town causing heavy casualties, d next morning I found the mixer rounded by knocked out aircraft und spattering of craters in the loading ron surface. I gingerly checked the xer for booby-traps or unexploded arges but it was clear. Needless to /, all military people now had much ore to concern them than air-lifting a ncrete mixer, so when I was able to t a berth a couple of days later, I w back to Ban Me Thuot hoping that e position would improve in a week so.

"In fact the opposite happened. The tack on Pleiku and other towns at the me period, plus threats to more, in- iding Ban Me Thuot, resulted in gent action to raise the security level roughout the country. All available rcraft were pressed into service evacu- ing women, children and other civili- is and rushing in troops and military pplies.

"It was two and a half months, and odness knows how many air-miles, ter the search started that an aircraft as made available, and I went to eiku to fly back with the mixer. The ree-ton wheeled monster took a lot persuasion to move just sufficiently to the aeroplane for the back ramp to ose — and then the crew calculated e loading. The craft was tail heavy, the mixer should be off-loaded. May- e it was the crestfallen look on my ce that influenced them — anyway, e captain said, 'I'll give it a go.'

"With the thing taking up the full idth and height of the fuselage, and raining at its chains with every move, didn't enjoy sitting in front of it in ight, and least of all when the propel- rs were slammed into reverse pitch nd the brakes jolted on at landing, but l was well and it was a big day in an Me Thuot.

"Getting a concrete mixer had by no neans been our only mast problem. xcavations had run into rock, and it as typical of our luck that one was ocated right on an underground water ourse that gushed out better than 200 allons per minute when digging had eached less than two feet below the ust dry ground surface. By using such umps as could be obtained, the hole as eventually dug, chipped, and blasted take the 15 cubic meters of concrete eeded. The rapid flow of water made necessary to line the excavation with sealed canvas bag and to pump con- nuously while pouring.

"This was our last block and by using orrowed cement and borrowed labour- rs and working Saturday instead of tak- ng the rest we all felt the need for, ne job was finished just a bit after dark. lext day it rained, and it was the 'wet eason' from then on. Had we delayed, doubt if all the pumps in Vietnam ould have helped us. The borrowed abourers were returned intact, but I eel that much time will pass before re- ayments of the cement are complete."

The almost daily rain throughout the rection of the giant mast, 620ft high ith 70ft diameter umbrella top, made ne work hazardous and generally diffi- ult for the erection team. Five months fter concreting work has finished, the eel structure was complete and all con- erned felt a mixture of relief, and nxiety on whether security measures ere going to prove adequate to prevent ne V.C. toppling it with one of two ell-placed charges. The problems of ne mast stood out particularly because to erect such a large structure under the prevailing conditions was obviously very ambitious. However, problems beset the remainder of the project at least as much and Giles states that it would be hard to name any aspect of the project that didn't bring its own train of difficulties. Even such simple needs as a ladder, a wheelbarrow, petrol and oil for team transport and working equipment, either couldn't be obtained or used up huge slabs of precious time seeking out and acquiring. Labour was a major problem in itself and of course the language barrier added its effect to nearly all aspects.

Boxing Day of last year showed the first real crystallisation of the Australian team's hard work, and tests were commenced with the transmitter connected to the mast and supplied with power from the diesel-alternator plant.

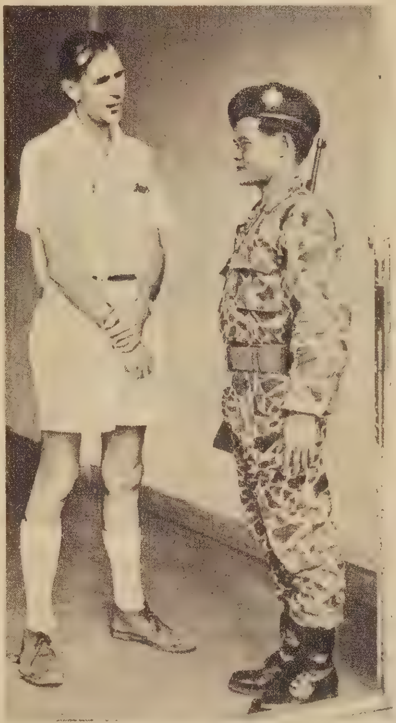
These tests worked up to exhaustive acceptance trials to satisfy Mr Roy Wightman, the P.M.G. Inspecting Engineer, that the installation was fully in compliance with Australian standards—despite what had gone before. The trials were complete on January 25, and the station was officially opened and inaugurated by the Prime Minister of South Vietnam, General Ky.

It is now manned by a team of Vietnamese technicians trained by the Australians and is operative for 18½ hours a day, five days a week and for 20½ hours on Saturdays and Sundays.

For their tireless efforts in the face of what, at times, appeared to be insurmountable difficulties, each member of the Australian team received a letter of commendation from the South Vietnamese Government.

The letter read: "The Minister deeply appreciates each member of the team for his invaluable assistance to make possible the construction of the 55,000 watt radio station at Ban Me Thuot. This powerful link in the broadcasting facilities of Vietnam will stand as a constant reminder of the important contribution by the Government of Australia to the successful outcome of the struggle of the people of free Vietnam against Communism."

"It's good to be home," said Giles, "and as six months stretched to 15, I wondered at times if I'd ever make it. I must admit though that to some degree I miss the almost ever present sound of 'choppers' and other craft, the war zone atmosphere, the breakfast table chatter, artillery fire and weapon bursts in the night, and living dangerously as is a natural consequence of driving a vehicle in that part of the world." ◘



Above: Chief project engineer for Standard Telephones & Cables, Mr Rex Giles, chats with an armed guard detailed to protect the transmitter project.

☆

Right: Two riggers at work on the mast. This was constructed during the "wet season" when it rained almost daily, making the work both difficult and hazardous.

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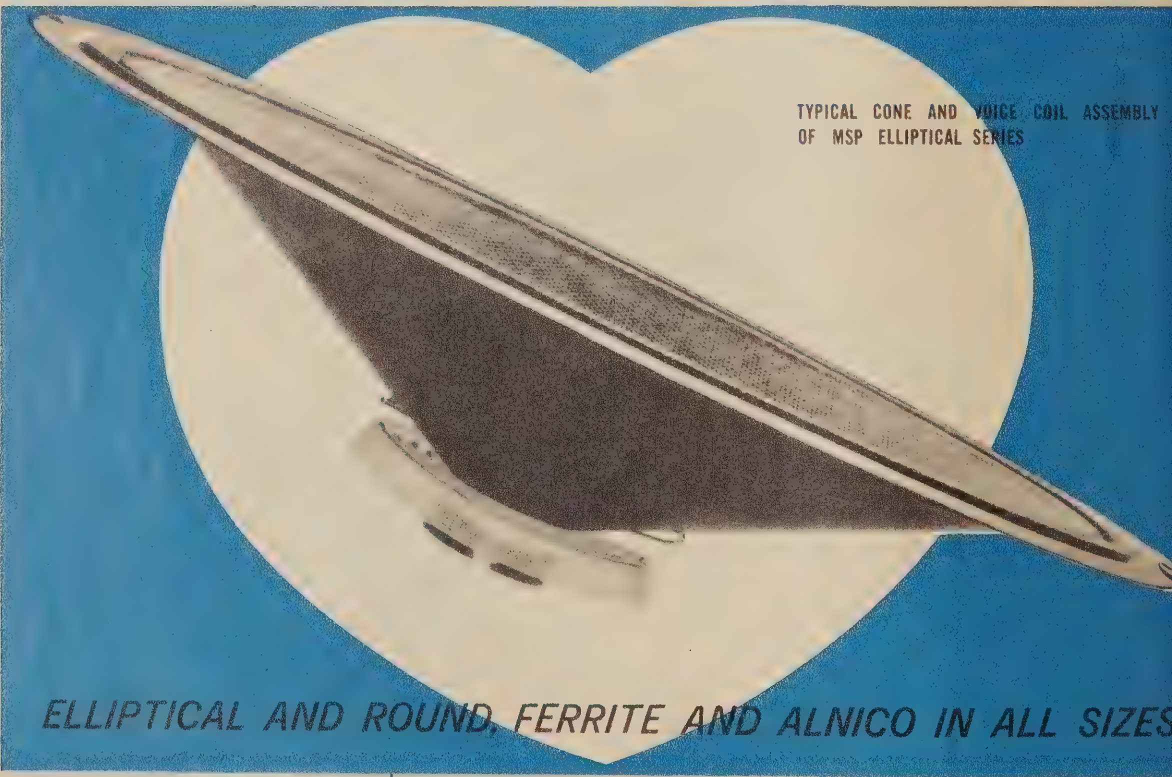
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INMANNED WEATHER SHIP

"NOMAD"

(NAVY OCEANOGRAPH METEOROLOGICAL AUTOMATIC DEVICE)

A nuclear-powered weather buoy is now broadcasting weather information at regular intervals from the Gulf of Mexico to monitoring stations in U.S.A. Operating completely unattended, the floating station transmits both general weather data and advance warning of hurricanes.

The weather station, known as NOMAD (Navy Oceanoraphic Meterological Automatic Device) was developed by ie National Bureau of Standards (U.S. Department of ommerce) for the Bureau of Naval Weapons of the U.S. avy. It is based on a design for a weather station originally eveloped in 1955 by William Hakkarinen and P. D. Lovell, f N.B.S. The present NOMAD, many modifications and iany years later, is powered from batteries kept charged y a SNAP-7D nuclear generator.

The NOMAD anchored in the Gulf of Mexico will oon be joined by additional NOMADs placed out of lorfolk, Virginia, and San Diego, California. Each station ill broadcast the following weather data, using the ontinental code: station identification, water temperature, ir temperature, barometric pressure, wind speed, wind irection, and integrated wind force. Each transmission takes bout two and one-third minutes and can be programmed occur at intervals, of one, three, six or 12 hours. These ansmissions should aid in predicting the arrival of storms arly enough for ships and planes to change course and r populated areas to make preparations.

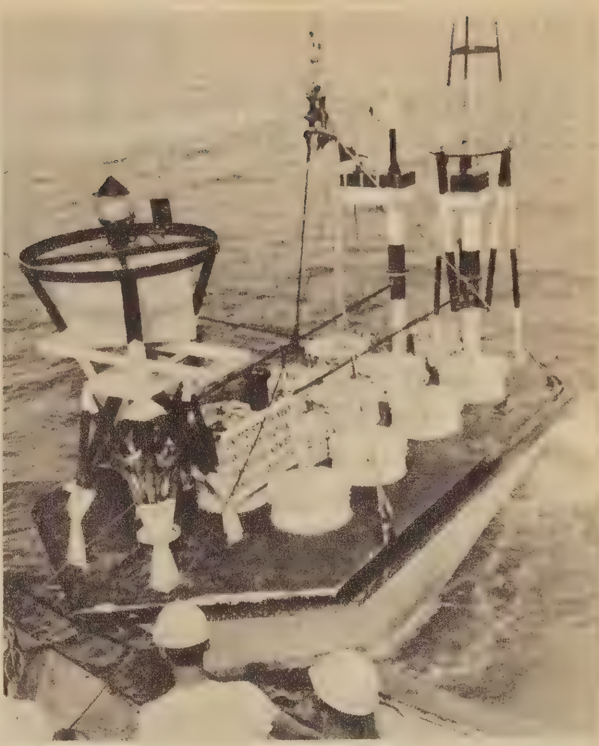
The 1955 NOMAD consisted of a 10 x 20ft noniagnetic float, designed by the Navy's David Taylor Model asin and containing circuitry powered by dry batteries. he present model looks much like the first one, but uses nproved circuitry and a nuclear power source. Many of s sensors, however, are similar to those of previous models. emperatures of the air and water surface are measured y thermistors having a high negative temperature coefficient. arometric pressure is converted to a resistance value by lamping the conductive pointer of an aneroid barometer a circular resistance strip at the moment of sensing.

Similar methods are used to sense wind speed and irection; the former is presented by a tachometer driven y a three-cup anemometer and the latter as the position f a magnetic pointer. IWF (the amount of time that the ind speed has exceeded a threshold value) is obtained om a multiturn potentiometer positioned by a DC chronoietric motor controlled by a pressure-plate anemometer.

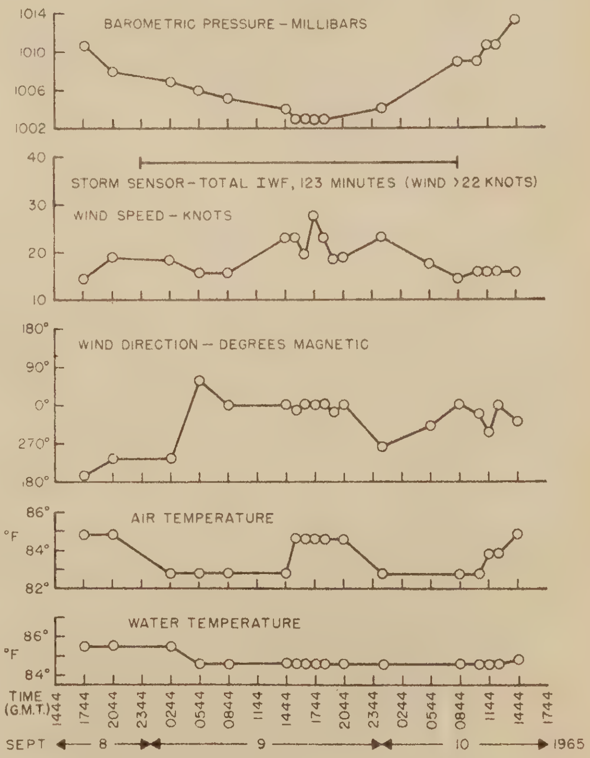
The resistance values supplied by these transducers are vitched in a fixed sequence into a self-balancing bridge. Vhen balanced, the bridge controls a selector and code enerator which expresses transducer resistance in terms of ie continental code. The generator keys a pulse-modulated ansmitter operating at 5340KC and a power of about KW. This signal can be received reliably over a distance f about 800 miles and has been reported to have been eceived over a path of over 1,600 miles. Excellent reception ver 500 miles was obtained during a recent hurricane.

Electrical power to operate the telemetry circuitry and avigational lights of the NOMAD anchored in the Gulf f Mexico is supplied by three series-connected, 4V nickeladmium batteries which are kept charged by the 50W NAP-7D nuclear generator. The SNAP-7D, which is iounted below the deck, is a thermoelectric generator perated by heat from the nuclear source.

Each of the other NOMADs in use obtains its power om 12V lead-acid batteries providing a capacity of 4000 mpere-hours. Two wind-chargers mounted atop masts charge iese batteries sufficiently for station operation over a practical length of time. Both models of NOMAD use 12V DC-10V AC converters to power some station functions. ■



Navy weather data station NOMAD being anchored in the Gulf of Mexico. Weather sensing devices visible in the picture include the anemometer for measuring wind speed, the wind direction indicator and the IWF-storm sensor.



The meteorological data seen in this series of graphs was transmitted during Hurricane Betsy by NOMAD, anchored in the Gulf of Mexico at a position 25°02'N,, 89°58'W. It was received and recorded at a Federal Communications Commission station at Fort Lauderdale, Florida, beginning September 8, and finishing September 10, 1965.

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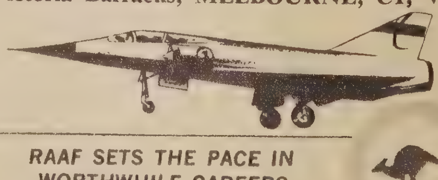

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Technical Review

MOON-ROCKET TV CAMERA USES FIBRE OPTICS

The techniques of closed circuit television and fibre optics have been combined in a surveillance system designed for America's Saturn V moon rocket. This article from the March, 1966, issue of "Boeing Magazine" explains how the TV system, which can see round corners, will be used.

by Robert Koch

Television, the entertainment medium ich has changed the living habits of illions, now is playing an important le in the U.S.A.'s space program.

A high-reliability television system ll be on the early versions of the st-stage booster of the Saturn V moon cket, which is being assembled by eing for the National Aeronautics and ace Administration at NASA's Mich- d Assembly Facility in New Orleans.

The system will transmit four views the engine operation and other func- ns from the time the fuelling com- ences on the ground until the stage parates at a height of approximately miles.

Designed by Boeing, the equipment atures four fibre-optics viewing sys- ms which "pipe" the images to two mote cameras located in the rocket's rust structure. Although the five 1.5- illion-pound-thrust engines are the stars the aerial TV show, extreme heat, ise and vibration prohibit installation the cameras in the engine area.

Quartz viewing windows in insula- d rugged mounts on the hot side of e heat shield will hold the ends of e fibre-optics bundles which "see" the gines. Both nitrogen purging and indshield wiping brushes will be used the viewing windows to ensure good age pickup.

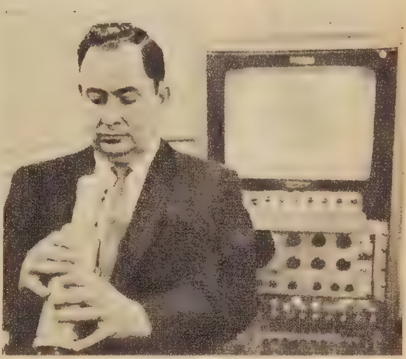
Two six-foot-long fibre-optics bundles, ch containing almost one million glass bres, will run to each of the two meras. Half of each camera's picture- ck-up tube will carry the view from e bundle, the other half will carry the cture brought in by the second fibre- tics bundle. The result will be four ews of the engines with each view owing the centre engine plus two out- ard engines.

Fibre-optics bundles have the advan- ges of being flexible and heat resist- t and of carrying a picture around rners as if it were going through a se. Thus two fibre-optics bundles can ing to a single camera lens pictures of o things which are widely separated.

Each individual glass fibre in a bundle ansmits a speck of light which bounces om wall to wall inside the fibre un- it emerges at the other end. As long the fibres are bundled together in the me way at each end, the pattern of light picked up carries through and emerges as a picture, in full colour.

Outputs from the cameras will be sent some 150 feet through coaxial cable to the top of the stage where they will be transmitted to the ground station as a composite signal. At the ground station the composite signal will be split and sent to two TV monitors.

Proper lighting, a main concern of any cameraman, will be a major consideration during this TV spectacular. If the first-stage booster is fuelled during the day, normal sunshine will help provide the lighting. If the stage is fuelled at night, artificial lighting will be needed. During flight the multicoloured brilliance of the engines' flames will be the source of light. It will be necessary to compensate for these extreme variations by electronic means.



A Boeing engineer working on the moon rocket TV system televises himself with TV camera.

The 250-pound TV system will occupy only two cubic feet on the first-stage booster. Operating in a severe environment, the picture-taking system represents a considerable advance in the state of the art of television application. ◼

MATCHBOX-SIZE TV CAMERA FOR MOON TRIP

A matchbox -size solid state television camera may be handling some of the photo assignments when United States astronauts make their trip to the moon. The miniature camera will contain no vidicon tubes and is expected to produce pictures with resolution comparable to that of commercial TV.

Crude pictures of moving objects have already been taken with the camera, according to Carl T. Huggins, of the National Aeronautics and Space Administration. However, says the N.A.S.A. engineer, who is in charge of the project, an operational version is probably still a few years off. The Aerospace division of the Westinghouse Electric Corp. is developing the camera for the space agency.

The system developed thus far uses a thin silicon wafer of less than one square inch as a mosaic sensing device. The wafer replaces the vidicon tube of conventional TV cameras and contains 2,500 sensing elements that are switched on digitally by simple logic.

Each element is made up of a three-layer phototransistor that controls a current which runs through it. The current, in turn, is modulated by the light that hits each element. Output from each of the elements is stepped up by a video amplifier before transmission.

All the circuitry is in micro-miniaturised wafers or chips and the power input is four watts and up.

Eventually, Westinghouse researchers say, a wafer of about the same size will contain 40,000 sensing elements on its surface. New production techniques must be developed to squeeze this number of elements on to the wafer. The small number, comparatively, of sensing elements now on the surface leaves wide spaces between each; this is one reason for the crude pictures so far. The fully developed camera will operate on only ¼ watt from a 28-volt power supply and weigh about a third of a pound, including all associated electronics.

Instead of an electron beam to scan each row of sensors, digital logic circuits scan the wafer at 60 frames per second. The scan rate is expected to be slowed eventually to 30, the speed at which commercial TV scans.

The system produces TV pictures composed of a series of dots rather than lines. With the 2,500-element system, the engineers calculate that the resolution is comparable to a crude 50-line TV system. When the 40,000- element system is perfected, they believe, resolution will be equivalent to 200 lines, approaching that of commercial TV. ("Electronics" Vol. 38, No. 10.) ◼

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TRANSISTOR RADAR RESPONDERS FOR LIGHTHOUSES

Lighthouses and lightships around the coasts of Britain and Ireland are to be provided with "Seawatch" radar responder beacons made by A.E.I. Electronics, of Leicester, England.

Skerrymore lighthouse in Scotland will be one of the first to be equipped with the A.E.I. transistorised radar responder beacons.

A signal from a ship received by the eacon causes it to transmit a 45 micro- econd radar pulse, providing a charac- eristic "paint" on the radar screen from hich mariners can directly observe the inge and bearing. The magnetron, hich is silicon transistor modulated, echanically sweeps the marine radar and once every two minutes.

The equipment consists essentially of n aerial, two transmitter-receiver units ne a standby) and a changeover unit. n case of breakdown, the standby unit utomatically takes over. All is solid tate, except the magnetron and the lystron. The beacon will operate con- nually over long periods, if necessary t unmanned sites, anywhere in the orld. Telemetry outputs can be pro- ided for remote operation.

A simple eight-step routine will en- ble the lighthouse keeper to trace 90 er cent of the faults to a sub-unit; the emaining 10 per cent require a visit y an engineer with test equipment. If he magnetron, klystron and mixer crys- als are changed regularly, faults are ot expected to exceed two per annum. utgoing alarm lines may be used to gnal that the standby receiver is in ction.

The aerial is mounted in a high posi- on on the lighthouse, or on a separate nast. Separate slotted receiver and ansmitter arrays are housed in a com- non radome, unless narrow beamwidth required, in which case a combined ansmitting-receiving aerial will be sed to reduce aerial size. The normal 60-degree azimuth pattern can be modi- ed by adding microwave absorbent naterial within the radome.

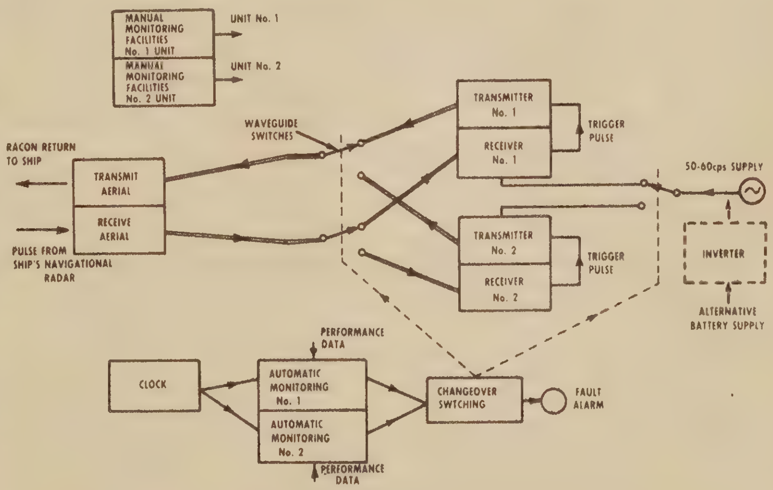
The superheterodyne, double sideband eceiver operates on the radio frequency and between 9300 and 9500MC. The gnals are received in a balanced nicrowave mixer, which is also fed from local oscillator klystron, the klystron ower supply being stabilised to reduce requency drift. An oscillator operating t 1KC provides the "fill in" frequency nodulation. The intermediate frequency gnal is amplified and after detection he signal is further amplified in a video mplifier.

The output of the video amplifier is sed to trigger a long pulse generator, hich has a built-in threshold to pre- ent unwanted triggering from noise. he output of this unit is in the form f a 90 microsecond pulse which in turn iggers a short (45 microsecond) pulse enerator and thence the transmitter. he use of two pulse generators in this nanner ensures that the magnetron duty ycle cannot exceed 50 per cent. Signal noise ratio is 15.75dB at 3×10^{-10} atts input.

The automatic monitor detects the existence of a fault in the operational unit, triggers an alarm and switches in the standby unit. This monitoring sequence is initiated at specified times, normally at each hour, by means of an electrically wound clockwork timing mechanism. The service is interrupted during this period for approximately two minutes, during which time there is no external radiation.

What happens is that waveguide changeover switches are operated so that the transmitter power, suitably attenuated, is fed directly to the receiver and the connection between the IF and video amplifiers is broken. A test pulse generator is connected to the video amplifier input and a test pulse detector to the IF amplifier output.

The test pulse generator should cause the transmitter to be triggered repeatedly and a train of pulses should be received at the test pulse detector via the receiver, if the equipment is functioning correctly. The pulse detector alarms if the amplitude of the received pulses falls below a threshold level (e.g., receiver gain or transmitter output power low), or if the pulse train is not continuous (e.g., klystron off-tune or magnetron output not continuous over the band). At the same time, a microwave resonant cavity is tuned over the band, monitoring transmitter frequency, while power output is checked by a detector. Failure of the transmitter to generate sufficient power with the required sweep pattern operates an alarm. The automatic monitoring sequence can also be applied to the standby equipment.



Block diagram of A.E.I. "Seawatch" beacon.

The sequence is designed to detect any of these fault states: Total performance loss of 9dB, transmitter power reduced by more than 6dB, transmitter frequency sweep incorrect, receiver frequency coverage incorrect, and receiver gain reduced by 9dB.

Built-in manual monitoring facilities, using a meter and lamps, enable semi-skilled operators to locate faults to a given sub-unit. All sub-units are readily interchanged. The klystron frequency can be set to centre band using a tuning aid. Manual checks can be carried out on the standby equipment without disturbing the operational equipment and without any external radiation. ■

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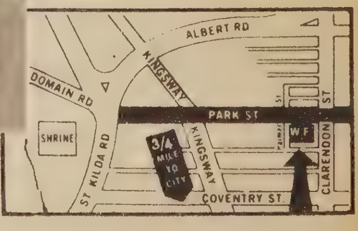

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HEART BATTERIES ARE CHARGED BY BODY FLUIDS

Body fluids, acting as an electrolyte, may enable implanted electrodes to provide longer-lasting batteries for pacemakers that keep faltering hearts beating.

With cardiac pacemakers, many people with heart trouble are able to lead lives that are normal in many respects except one—fear that the pacemaker battery may fail. This concern has led to experiments in making the body a partner in supplying its own lifesaving power.

Although body fluids can act as an electrolyte in generating enough power for a pacemaker, researchers still must find the most suitable metals for the electrodes and the best sites for implanting them. It is conceivable that the stimulator and power source can be implanted right in the heart.

When it first came into common use, the pacemaker—which stimulates the beat of faltering hearts electronically—was considered to have a life expectancy of four to five years. Subsequently, this figure was reduced to 15 months. Improvements in lead construction, component selection and impregnation techniques have reduced failures considerably, but the pacemaker's life is still limited by the life of the power source.

To stimulate the heart with electrodes sewn on its muscular tissue, 16 to 20 microjoules are required. This energy is usually transferred to the heart in the form of a pulse with a duration of two milliseconds. The stimulus rate is usually set to produce 60 to 70 heartbeats per minute. The average current then drawn from the battery is about 50 microamperes. This includes the current required to overcome all losses in the pulse circuitry. To operate 10 years, the battery should have a capacity of 4.5 ampere-hours.

Many cathode and anode materials have been tested for use with a body fluid. Over the past two years at the University of Toronto's Banting Institute, such work has been directed by Dr W. G. Bigelow, an assistant professor of surgery at the university and chief cardiovascular surgeon at Toronto General Hospital. For cathodes, platinum black, silver and silver chloride have proved most consistent in potential developed and capacity. Materials of pure zinc, iron and carbon or mild steel have also been tried as anodes. Zinc appears superior to the others, but results are inconclusive.

When platinum black or silver is used with any of the anodic materials tested, the body fluid supplies not only the electrolyte, which provides ionic conduction between the electrodes, but sufficient oxygen to serve as the depolariser at the cathode. With a 50-microampere drain, such a battery needs oxygen at the rate of 0.01 cubic centimetre an hour for depolarisation. Some typical measurements made on a galvanic cell with a 50-microampere load are in the accompanying table. These measurements were made over a period of several weeks at room temperature with the electrodes immersed in a normal saline solution.

When platinum black and carbon or mild steels are used as electrodes, the steel behaves galvanically like iron. It even corrodes at the same rate. Steels with higher chromium content, however, make poor cathodes, since the chromium retards corrosion and the amount of energy produced is insufficient. A battery with silver chloride and zinc electrodes operates well within the body and produces a potential difference of 1 volt at currents up to 10 milliamperes. This power source has its own depolariser, chloride, and the body fluids behave as the electrolyte.

Of anode materials tested, it seems certain that zinc is superior in potentials developed and capacity. Silver chloride-zinc and platinum black-zinc batteries have been implanted in dogs and rabbits for periods of up to nine months without ill effects.

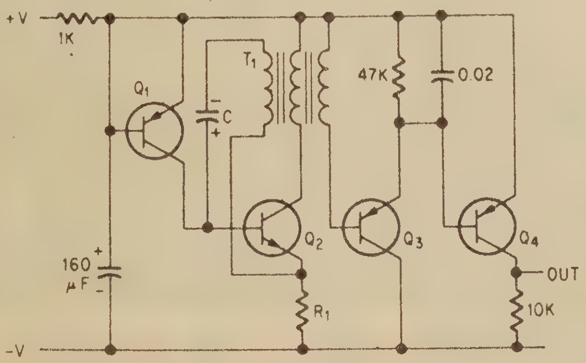
The circuit diagram of the first series of body-fluids pacemakers tested in animals is shown below. The circuit consists of a ringing-choke oscillator with feedback supplied to the base of transistor Q_2 by the secondary winding of the transformer T_1. The rectifying action of the base-to-emitter junction of Q_2 lets the oscillations charge the capacitor C_1 until Q_2 is cut off. The transistor Q_2 remains off until C1 has been discharged through the resistor R_1 and the constant current source Q_1 to sufficiently lower the base bias to its original value. The current source serves to stabilise the output rate of the stimulator against variations in the battery voltage. With a resistor in the base biasing circuit, the rate of the pacemaker output varied from approximately 30 beats to 180 beats per minute for battery voltage changes from 0.5 to 1.5 volts.

The remaining circuitry acts as an impedance transformer that matches the battery to the pulse circuit. At a battery voltage of 1 volt, the stimulator produces a 0.9-volt pulse of 8 milliseconds duration into a 500-ohm load at an average drain of 50 microamperes.

Stimulators were implanted into a series of dogs in whom a heart block had been induced. The battery electrodes used were either platinum black-zinc or silver-zinc. The cathodic material was either implanted just beneath the skin or beneath the skin near well oxygenated tissue such as muscle. The anodic material was separated from this cathode by 1 to 20 centimeters: for example, the platinum-black electrode near the muscle of the right flank and the zinc electrode in the abdomen. Separation is was found, had very little to do with performance of the pacer. The stimulating leads were attached to the the surface of the right ventricle.

It was found that this stimulator did capture and control the heart's beats and worked well for a period of 48 hours. After this time, the heart muscle ceased to respond to the stimulus. Upon investigation it was found that the resistance of the heart had risen, either through fibrosis around the leads or chemical changes in the tissue beneath the stimulating electrodes. And a one-volt pulse was now insufficient to transfer enough energy into the heart to maintain pacing.

As a result, a new pacemaker, using a ringing-choke converter was designed. Here a step-up transformer T_1 is used with transistor Q_1 to form an oscillator which converts the galvanic potentials to AC. The stepped-up voltage is then rectified and used to drive a stimulator similar to the one previously described. This pacemaker with the converter produces a 1-millisecond pulse of 6 volts across a 500-ohm load. The efficiency of the converter is approximately 30 per cent. These stimulators are now being implanted and their long-term effect being studied. ("Electronics", 21/3/66.)



Galvanic cell measurements

Cathode material	Anode material	Voltage (volts d-c)	Anodic material loss
Platinum black	Zinc	0.9 to 1.0	550
Platinum black	Iron	0.5 to 0.6	468
Platinum black	Mild steel	0.5 to 0.6	468
Silver	Zinc	0.8 to 0.9	550
Silver chloride	Zinc	1.0 to 1.1	550

Typical measurements of batteries with different electrode materials immersed in a saline solution. The anodic material used as fuel is calculated in milligrams per year.

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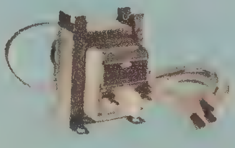

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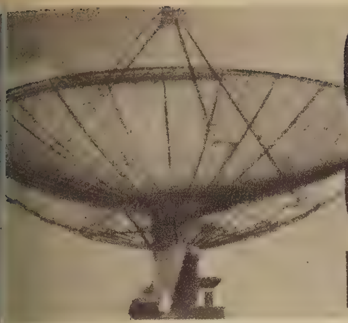


SCIENTIFIC AND INDUSTRIAL NEWS

Hydrostatic car transmission

A revolutionary transmission system for motor vehicles is under development in the U.K., at the national Engineering Laboratory near Glasgow. Instead of the conventional gearbox, clutch, transmission and differential, the wheels are turned by oil forced directly to the road wheels by a pump. The engine drives the pump, which sends a high-pressure flow of oil to small transmission motors mounted at the wheels, where the pressure is translated into driving force.

The inventors claim considerable advantages for the new system, particularly for heavy vehicles. For example, the constant starting and stopping of buses causes wear in conventional systems, but the new hydrostatic system shows no noticeable effects under these conditions.

Since the driving engine can be placed anywhere in the vehicle, designers are free to plan new shapes and body styles not possible within the restriction of the present system.

A test vehicle using the new system was described in a recent B.B.C. World Service program, and was said to be very little different in appearance from normal vehicles. The only difference on the dashboard was the addition of two pressure gauges that record the behaviour of the hydrostatic system. Only two foot pedals were used, one being the conventional brake, the other called a "momentum pedal." This is the vehicle's accelerator, but is somewhat different in principle from the standard type. If the driver presses with his toe the car moves forward, but if he presses with his heel the vehicle goes into reverse. This reversing action can be used to bring the vehicle to a rapid halt in the event of an emergency.

Toroids magnets from Malaysia

The Industrial Machine Co. Ltd., of 16 Bishop Street, Penang, Malaysia, invites inquiries relating to a new range of cylindric toroid magnets that it has developed for such applications as precision instruments, loudspeakers, generators, magnetic clutches and similar equipment.

The magnets are available in most of the standard alloys in either fully machined and magnetised condition, or as unmachined units. The company will give assistance in redesigning equipment at present equipped with conventional magnets on receipt of relevant information, and makes no charge for feasibility studies. A booklet describing the magnets with notes on theory and applications to various types of equipment is available free on request.

Plastics that conduct

As a result of the latest work done in Russian laboratories on electrically-conducting plastics (Plasticheskie Massy No. 3, March, 1966) it is found that when epoxy resins have dispersed nickel in them and the amount of hardening agent and the temperature are increased, then during hardening the specific resistance decreased more than expected. Diethylentriamine is necessary for the process.

An increase in the internal strains in the resins is accompanied by a reduction in the resistance due to the development of contacts between the particles of electrically conducting metallic aggregate (that is, the nickel).

The basic ingredients of the Soviet conducting plastics were ED-5 epoxide resin with an epoxide number of 21 and 37 per cent electrolytic nickel which contained 99.795 per cent nickel.

British satellite consortium

Three British companies, Plessey, G.E.C. and A.E.I., have formed a consortium to build and sell complete communications satellite ground terminals. The companies estimate that the market for such terminals for civil use is around £stg100 million ($240 million) and the consortium has been formed to capture a major share cf this business for Britain.

Joint engineering teams are already at work on designs to meet the requirements of this international market, although the operational structure and organisation of the consortium is still being completed.

New commutator brush alloys

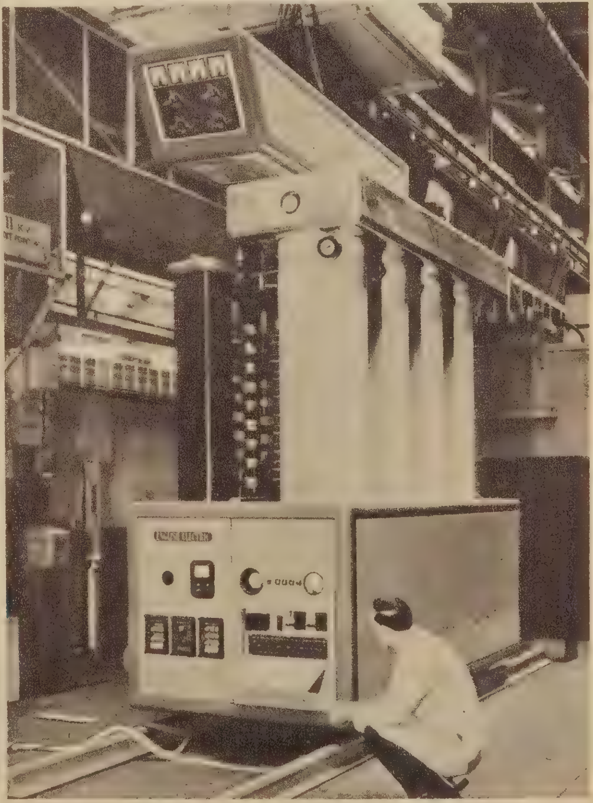
New bronze alloys have been developed in the Soviet Union for use in the collector and commutator brushes of heavy-duty electrical machinery, reports Elektroteknika, Volume 3, for 1966.

The alloys combine hardness, strength, heat resistance and high electrical conductivity, and are designed for applications where temperatures reach 350 degrees to 500 degrees Centigrade.

They are based on bronze, alloyed with chronium zirconium, chromium magnesium or nickel/beryllium. The chromium content ranges from 0.25 to 0.5 per cent, zirconium or magnesium from 0.15 to 0.35 per cent, nickel 0.8 to 1.1 per cent, and beryllium 0.15 to 0.25 per cent in the three different alloys.

These conducting bronze alloys replace electrolytic copper, which loses strength through recrystallisation at about 200 degrees or lower, the article says.

Heat treatment of the alloys before use includes quench hardening in water at 960 degrees to 890 degrees, cold drawing, with a 50 per cent reduction in cross-section area and tempering at 470 to 480 degrees for four hours.



At the works of the English Electric Company Ltd., at Stafford, England, a technician adjusts this first British-made four-anode mercury arc valve for high voltage direct current transmission. English Electric Company will manufacture 56 valves of this type for Britain's Central Electricity Generating Board, for incorporation into the National Grid. Direct current transmission has not yet been used in Australia, but is used in New Zealand for an interconnection system between North Island and South Island.

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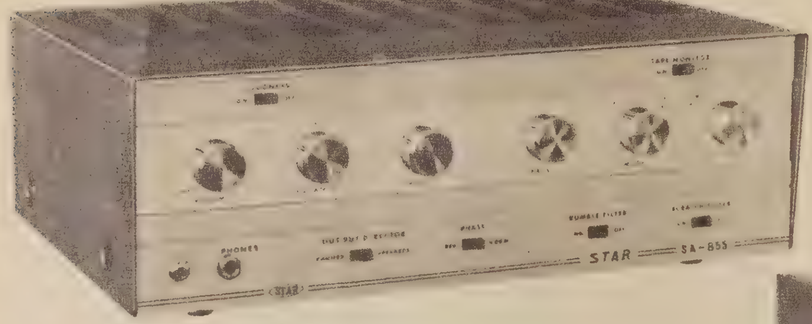

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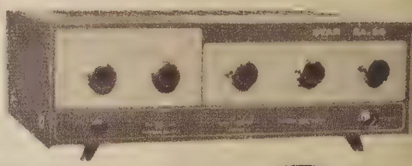

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MCX.

This new machine developed in Britain by Standard Telephones and Cables Ltd. can produce thin film microcircuits automatically and at high speed. It is controlled by punched tape and is said to produce the microcircuits adequately and cheaply without the need for detailed large-scale drawings. Control tapes are compiled from a sketch drawing on graph paper. Tapes consist of a series of co-ordinates of positions on the diagram, and instructions to start or stop engraving. Tracks are cut by an electrode stylus which remains fixed while the microcircuit is moved according to the taped instructions.

harpens drill points

The range of twist drill point grinding machines manufactured Sweden by Wedevags Bruks AB, Vedevag, now includes one hat covers drill sizes from 3/32in to 21/32in. The machine is emi-automatic in that it is only necessary to apply the feed, once ther settings have been made. The configuration produced on the rill is said greatly to reduce axial resistance when cutting and nere is a consequent reduction in the power required to drill holes.

A second improvement claimed is that the drills centre themelves easily and, as they tend to run true, they do not score the alls of the hole being drilled.

ual function motor

In co-operation with the Technological University of Delft, hilips, of Eindhoven, Holland, has developed a dual-function lectric motor for use with simple numerical positioning systems.

It can function as a stepping motor, in which case it makes 00 steps per revolution in two seconds, or it can operate as n asychronous motor with a nominal speed of 1500rpm. With machine too, the motor can be used for positioning at a rate f five metres a minute and as a stepping motor for fine positioning with a speed of 12 centimetres a minute.

arconi/Ferranti agreement

In Britain, the Marconi and Ferranti companies have signed licence agreement under which the Marconi Company will anufacture and sell the range of advanced silicon microcircuits esigned and sold by Ferranti under the name Micronor II. nnouncing the agreement, the two companies say the arrangeent will not only increase the production capacity available for this new range of integrated circuits, but it will also provide a second source of supply.

The two companies claim that they already manufacture more than 70 per cent of the silicon integrated circuits produced in the U.K., and that the new agreement will provide them with greatly increased sales potential in world markets in the integrated circuit field.

Machines operated by speech

Experiments with machines which can be operated by the spoken word are going on in various parts of the world and, according to one forecast, may come into limited use in seven or eight years time.

Scientists hope eventually to develop machines that will translate spoken words into a foreign language and machines that will type as they receive dictation. Once this stage has been reached, the technique could be developed further so that really big machines could be made to operate from instructions called out by the operator.

A report from Western Germany states that a machine has already been built at Bonn University's Phonetics and Communications Research Laboratory which "understands" a few Italian words and types on command.

In Japan, scientists are experimenting with a typewriter which is operated by speaking into a microphone and they are also carrying out experiments with a system which converts printed words into a voice.

Work in this field is also being undertaken in Britain, Sweden, Switzerland, Russia and the United States. It was only this week that the Radio Corporation of America announced jointly with the United States Air Force that an experimental speech recognition system had been developed for the direct control of typewriters, telephones and computers.

More than a million characters of information can be stored on the disc cartridge (lower right) used with this new IBM 1130 computing system. This desk-sized computer is the lowest priced in the IBM range, but it is capable of undertaking a wide variety of tasks. Five new programs recently added to those available enable users to perform jobs ranging from automatic type composition to optical system design. At the recent Computer Conference at Canberra, IBM showed the machine equipped to set type, simulate the action of the human heart, plot a sales curve, plan an engineering project, or design a camera lens, tasks which formerely required a much more costly system. All data and instruction associated with a program can be stored on the disc cartridge, which is about the same size as a gramophone record. The 1130 is shown here with a punched card unit, one of five accessory units for expanding its capabilities.

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†Sensitivity : −52 dB±3 dB,
Dimensions : 148×48×34.5 mm without stand
Cable : 4 ϕmm, 3 m
Weight : 1¼ lbs (525 g)

DF-1DE

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 385.5 mm high
21 mm diameter, microphone
128 mm diameter, stand
Cable : 4 ϕmm, 1.5 m
Weight : 1⅝ lbs (840 g) with cable

*DF-14B

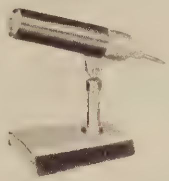
SPECIFICATIONS
Impedance : 50 kΩ Variable
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −48 dB±3 dB,
Dimensions : 136×75×47 mm
Cable : 6 ϕmm, 4 m
Weight : 2 lbs (900 g)

*DF-22B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 32.5 mm diameter, 220 mm long
Cable : 6 ϕmm, 4 m
Weight : 1¼ lbs (575 g)

DF-1/*DF-1B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8 d
†Sensitivity : −57 dB±3 dB,
Dimensions : 21 mm diameter, 82.7 mm lon
Cable : 3 ϕmm, 1.5 m
Weight : 3.9 oz (110 g) with cable



DF-3

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±8 dB
†Sensitivity : −56 dB±3 dB,
Dimensions : 33.5 mm diameter, 133 mm lo
Cable : 4 ϕmm, 1.5 m
Weight : 9.0 oz (255 g) with cable

DF-12/*DF-12B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 80~12,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 23 mm diameter, 158 mm long
Cable : 3 ϕmm, 1.5 m
Weight : 6.3 oz (180 g) with cable

*DF-2B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±10 dB
†Sensitivity : −56 dB±3 dB,
Dimensions : 75×53×30 mm
Cable : 3 ϕmm, 1.5 m
Weight : 4.8 oz (136 g) with cable

*DF-51B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~8,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 98×58×36 mm
Cable : 6 ϕmm, 1.6 m, Coiled
Weight : 7.3 oz (207 g) with cable

* with switch : † at 1,000 c/s, 0 dB=1 V/μ bar

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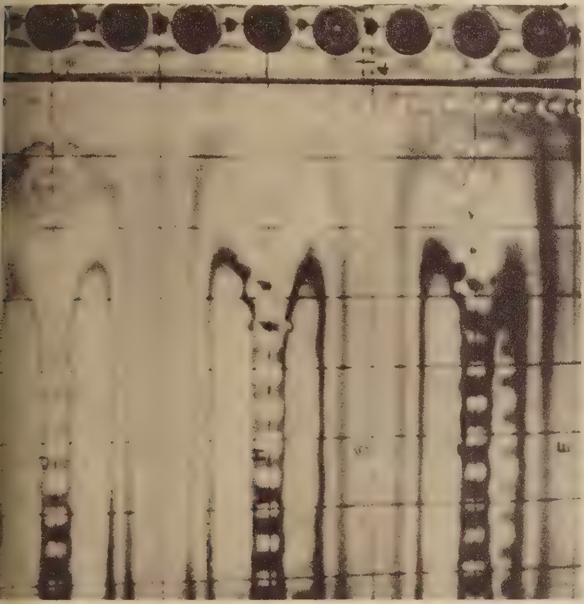
Optical character reader/sorter

New equipment which can read and sort 20,000 to 25,000 ocuments an hour, feeding information direct to a computer or recording it on magnetic tape, was shown at the recent Hanover Fair.

The optical character reader/sorter, made by Standard Electrik Lorenz, Stuttgart, Standard Telephones and Cables' German associate, reads numerals in international font OCR-A rom cheques, invoices and similar documents and sorts the documents into 12 output pockets.

Optical character recognition equipment of this type, which can read data printed with ordinary ink by business machines uch as typewriters, adding machines, and high-speed printers, offers the possibility of reducing the cost of input to data processing installations.



Reminiscent of a cathedral window, this photograph of a titanium wing panel under structural test at the Lockheed-California Company, depicts stresses on an aircraft in supersonic "flight" revealed by polarised light. Variations in colour indicate intensity of stress under dynamic loading. Strain gauges and other instrumentation are also used to record details for analysis. Titanium is the phenomenally strong, light, heat-resistant metal which will make up most of the structure of Lockheed's supersonic transport. Its special ability to withstand heat permits flight far faster than is possible for aluminium aircraft.

Copper as strong as steel

"A new kind of copper which is as strong as some kinds of steel, even at high temperatures, has been developed by the English Electric Company," reported Denis Desoutter in the B.B.C. World Service.

"The process by which it is made is one of powder metallurgy. Powdered copper is mixed with the correct amount of very finely powdered aluminium oxide, and the mixture is then heated and extruded to form bars of stock material. The resulting high-strength copper has electrical conductivity almost as good as that of pure copper, so that it is ideal for use in electrical work. It will make possible improvements in rotating electrical machines—motors and generators; it will be ideal for self-supporting conductor cables, which at present often have to be hung from steel wire, and it will make possible brazed and welded joints which have not been possible up to date. In fact, it is a development which opens a new career for copper as an engineering material."

Modernising videotape recorders

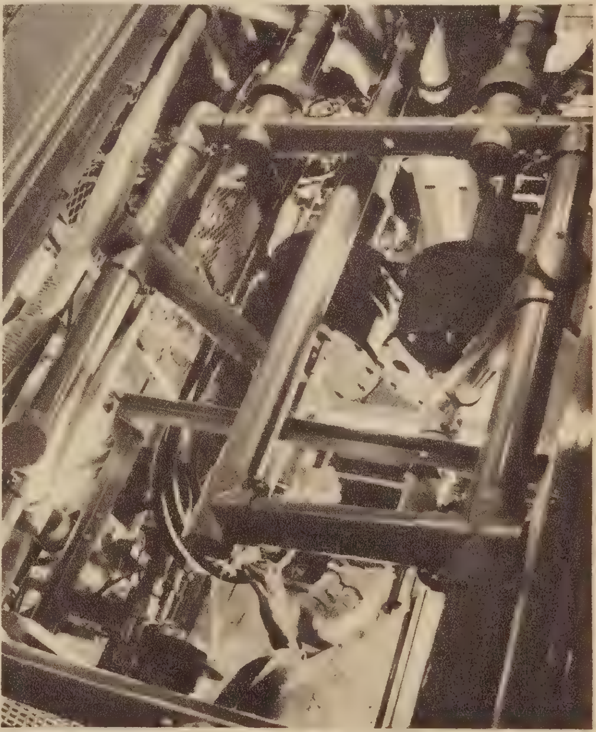
A modernisation kit to modify Ampex VR-1100 and VR-1000 series videotape recorders for high-band recording has been developed by Ampex Corporation, 401 Broadway, Redwood City, California. The kit was demonstrated for the first time in public at the recent National Association of Broadcaster' Convention in Chicago. Ampex say any VR-1100 and VR-1000 low-band videotape recorder currently in use can be modified for high-band operation using the new kit. Major components supplied with the kit are the VR-1200 signal system, a new Mark Ten head assembly and improved power supply.

The high-band standard of videotape recording is said to permit greatly improved picture quality over the former low-band standards, and to allow third generation colour tape duplicates to be produced without significant deterioration in picture quality. Sixth generation monochrome duplicates may be produced with the quality of a low-band master, Ampex says. (For figures on high and low-band systems, refer "ELECTRONICS Australia," May, 1966, page 50).

Self-tapping stud for engineers

A simple little innovation which is expected to save a good deal of money in the engineering industry is a self-tapping stud, described recently in a B.B.C. World Service program, in the following terms.

"A stud is one of those things that, for example, hold the cylinder head down on a car. It looks like a threaded bolt sticking up out of the cylinder block. It didn't grow there, it is threaded in by its other end, and that means first drilling the hole and then cutting the thread with a tap before the stud can be screwed home. But now a firm called Tappex has produced a stud which cuts its own way in. It is a combination of tap and bolt. It does away with the separate operation of tapping the holes, and it eliminates the need to buy taps and hold them in stock. It is just another of those ideas so simple that you wonder why nobody did it before. Already it has brought Tappex inquiries from all over the world."



This collection of "plumbing" is part of the radio frequency vision and sound combining filter of an ultra-high frequency television transmitter for the British Broadcasting Corporation's B.B.C.-2 network in Britain. It is seen here under test at the Cambridge works of Pye-TVT Ltd. British manufacturers claim that in design and performance, Britain's ultra-high frequency television equipment leads the world.

Corrosion inhibited

A Soviet monthly on the technology of fuels and lubricants — Khimiya I Tekhnologiya Tonliv 1 Masel — No. 1 of 1966, reports a trend in the Soviet Union towards the use of corrosion inhibitors based on nitrated petrolatum products.

The article says that currently inhibitors are made by a petrolatum oxidation process which is laborious and relatively costly because of the large amount of air needed, the high temperature, catalysts and separation processes after oxidation.

The nitrated products can be made at 65 to 70 degrees C and can be either oil-soluble or oil-water soluble, the latter compound being much superior to existing products for both ferrous and non-ferrous metals. Both are simple to manufacture in ordinary equipment, the report asserts.

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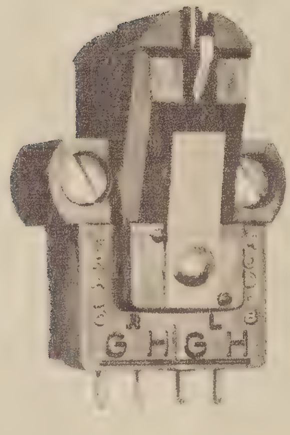

The output voltage of the Grado Model B cartridge is produced by two exceedingly small stress generators with an absolutely flat frequency response D.C. to 50,000 Hz (constant velocity).

As the cartridge contains no wires, coils or solder joints, and the internal impedance is only 12,000 ohms, it is completely insensitive to magnetic and electrostatic hum pick-up, as well as to normal temperature changes, atmospheric condition and physical deterioration.

Construction employs 24 carat solid gold ribbon connectors, military specification reliability, thermo compression bonded electric joints and ultra lightweight, hand polished diamond tipped stylus.

It is designed to be connected to standard 47,000 ohm 'magnetic' input terminals as available on any good quality stereo amplifier and has a stylus assembly which can be easily changed without tools.

With outstanding square wave response, rich full bass, exceptional transparency and smooth wide range, the Grado B cartridge, at a price you can afford, is a 'must' for those who seek only the best.

CARTRIDGES

Model BE	**£19.10.0**	($39.00)
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Model BE/S	**£13.0.0**	($26.00)
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BT/RS	**£4.17.6**	($ 9.75)
B/3S	**£7.2.6**	($14.25)

(for 78 r.p.m.)

The MINI-DUSTER, also available, attaches to any 'B' cartridges (latest models). With free swinging lateral and vertical motion the Mini-Duster cleans record grooves immediately in front of the stylus. Does not impair performance characteristics of the cartridge in any way. Obtainable at slightly extra cost.

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ntensifying light images

An electronic image intensifier, which ultiplies the strength of available light a illion times, is being produced by EMI ectronics, of Hayes, Middlesex, England.

This high light gain makes the four-stage age intensifier, type 9694, of particular terest for security applications and ientific work. Overall dimensions are 12in ng and 4.75in diameter when encapsulated silicon rubber. A permanent magnet focung system is available. The ability to record ngle electron scintillations brings the innsifier performance close to that theorecally attainable from the high sensitivity 20 photo-cathode employed, while the outt phosphor gives sufficient brightness for upling to a television camera system. ither direct or television read-out is feable.

lectronic circuitry

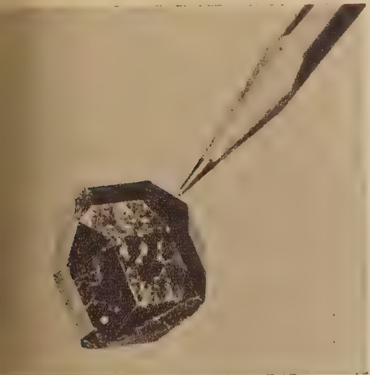
Standard Telecommunication Laboratories f Harlow, Essex, England, is applying spark achining in a microscopic way to thin lm work for use in advanced electronic ircuitry. Using a point electrode and the ery low input energy of 24 volts, the S.T.L. esearch team has found it possible to mainin the required correct spark gap of a few icrons. This is achieved by vibrating the ngraving stylus as it is traversed over the urface. In this way it makes and breaks ontact with the film surface, providing the ritical gap conditions during each halfycle of vibration.

The performance achieved with this achine is claimed to be comparable with hat of electron and laser beams used on hin film machining work. Speed is about ne centimetre a second (See story page 12)

Miniature lithium batteries

Pound for pound, lithium batteries pronise to be at least four times as efficient s other batteries now in use, claims Gulton ndustries, of 202 Durham Avenue, Metuhen, New Jersey. The company says its experimental lithium cell produces 100 watt-hours per pound of weight, compared to 26 watt-hours for nickel-cadmium batteries. The theoretical efficiency of Lithium, it adds, is 600 watt-hours per pound.

Since lithium (a light silvery-white metal) is extremely reactive with water, the company uses it in a hermetically sealed cell with a non-aqueous electrolyte.



Yttrium iron garnet (YIG) and Yttrium gallium iron garnet (YGaIG) crystal spheres 0.3in diameter or larger, and rods of various sizes, are now available on a commercial basis from Litton Industries' Airtron Division, Morris Plains, N.J., U.S.A. These crystals are used in microwave filters, delay lines and other components. The YIG crystals have a saturation magnetisation of 1780 gauss and a line width of about 0.35 oersteds. With YGaIG crystals, saturation magnetisation varies between 15 and 1750 gauss, depending on the amount of dopant.

Reinforced bolts and screws

Bolts and screws made of plastics reinforced with glass fibre have been patented by Licentia Patent-Verwaltungs G.m.b.H., Theodor-Stern Kai 1, Frankfurt (Main), Germany. Great shear strength is claimed for the components, which are designed specifically for high-duty electrical purposes.

This is a scale model of a satellite communications ground station being built at the Marconi Company's works at Chelmsford, England, for Cable and Wireless Ltd. This will be the first British civil ground station to go overseas, and will be installed on Ascension Island to take part in the American APOLLO moon-shot program.

Heat-dissipating enamel

Black enamels that will protect steel from corrosion and also dissipate heat may be used at up to 1,700 degrees Fahrenheit, reports the University of Illinois. A study of the enamels is available from the Clearing House, Springfield, Virginia, for 90c (U.S. $1) — reference AD 278,103.

Black oxides are added to quartz-barium-borax frits and the sheet enamelled in the usual way. The black coating is intended for Iconel and stainless steels. The enamel, it is stated, not only dissipates more heat than ordinary ones but also has better thermal conductivity.

Tapes warn of buried pipes

Brightly coloured plastic tape buried in the ground a few feet above pipelines and gas or water mains is said to reduce incidents in which excavating machines accidently cut into the mains.

Griffolyn Company, P.O. Box 33,248, Houston, Texas, says the tapes are colourfast and have a long underground life. They are colour-coded to show what type of pipe lies beneath. Excavators turning up the tapes know they are nearing pipes. ▬

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Logic and counting circuits — 2

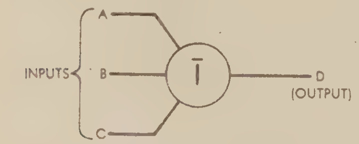
From EQUATIONS to "HARDWARE"

The operations NOR and NAND—techniques of "minimalisation"—the Karnaugh map—practical circuitry—positive, negative and mixed logic—a logic demonstrator—commercial logic blocks—block loading: "fan-in" and "fan-out."

by Jamieson Rowe

When the elementary logical operations AND,OR and NOT and the laws describing the relationships between them were introduced in the first article, mention was made of the procedure of minimalisation. It is proposed to discuss minimalisation in some detail in the present article, but before doing so it will be worthwhile to spend a short time introducing two further logical operations: NOR and NAND. These are actually combinations of the elementary operations discussed last month, but are conveniently considered in practice as being themselves elementary.

The NOR operation (also called the "Pierce arrow function" after its originator, C. S. Pierce) is virtually a complementary-OR or **NOT-OR** operation: if you like, an OR operation in which the output is negated. It is symbolised by



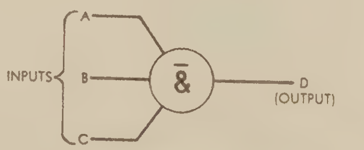
This situation exists where the following equation applies:

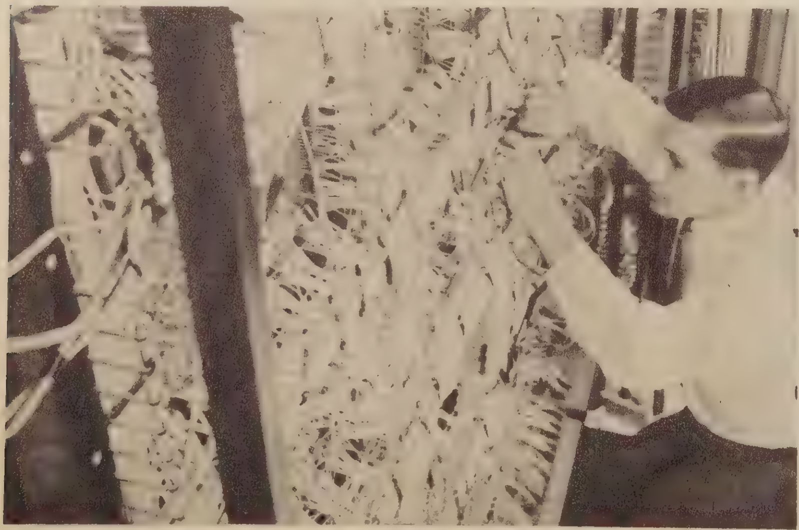
$$D=\overline{(A+B+C)} \qquad \ldots (1)$$

The truth table definition of the NOR operation is

INPUTS			OUTPUT
A	B	C	$\overline{(A+B+C)}$
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

The NAND operation (also called the "Sheffer stroke function" after H. M. Sheffer, its originator) is in similar fashion a complementary-AND or **NOT-AND** operation; an AND operation in which the output is negated. The symbol for the NAND operation is





Logic circuitry plays an important part in digital equipment.

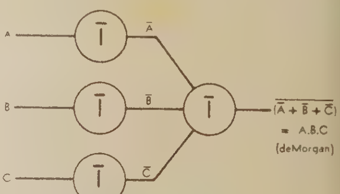
This represents a situation where

$$D=\overline{(A.B.C)} \qquad \ldots$$

The truth table definition of NAND operation is

INPUTS			OUTPUT
A	B	C	$\overline{(A.B.C)}$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Because they are "comple operations, both containing two of t elementary logical operations, the NC and NAND operations may be used "universal building bricks." Any logi operation, no matter how complex, c be performed by a suitable combinati of identical elements performing eith the NOR or NAND operation. For e ample, to perform the AND operati upon three terms "A," "B," and "C," u ing NOR operations, four NOR elemen would be connected together thus:



It may be seen that this particul configuration makes use of the first la of deMorgan's theorem, as stated la month in equation (3).

Although using only NOR or NAN elements to synthesise all logical ope ations might appear to involve mo elements than if the basic elements we all used, it often proves in practice be the more economical approach. Th is partly because the NOR or NAN circuit blocks become the "univers building brick," and may be mass-p duced in large quantities.

Apart from this, it is often found complex logic circuits that the desir logic operations may be re-arranged that they involve scarcely more NOR NAND elements than if the basic AN OR or NOT elements were used. Th while the above example would sugge that no less than four NOR elemen would be required to perform each AN operation, in practice three of the (those used as inverters) will often unnecessary as the complements of t inputs will be available from other se tions of the circuit. Either this, or it possible to reverse the so-called "log olarity,” as will be explained later in is article.

Such techniques comprise one aspect f the general design procedure called **inimalisation.** As mentioned in the rst of these articles, minimalisation is e name given to procedures for nding the minimum number of circuit lements which will perform the required omplex logical operation or “function.”

Together with the practical minimalation techniques of operation re-arranement and logic polarity reversal, there a somewhat more fundamental techique, one which is logical in nature ather than electrical. It is called **“findng the prime implicants,”** where the rime implicants are defined as those inimum terms required to completely escribe the complex logical function oncerned. In other words, this aspect f minimalisation is a process of reducng the complex logical function down o its bare essentials.

This may be performed in a variety f ways. One can simply sit down with encil and paper and try to whittle down he logic or circuit diagram in timeonoured “cut and try” fashion; or alernatively, one can manipulate the logic quation describing the complex funcion, using the various laws of combnation which we discussed in the first rticle to arrive at the simplest formuation. However both these methods tend o be somewhat unreliable at best, and lso rather unwieldy when the function oncerned deals with more than about our input “variables.”

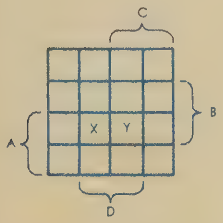


Fig. 1

Where more than about four variables are involved, it proves useful to employ graphical ahd topological methods. Probably the most popular of these is the Karnaugh map method, developed by M. Karnaugh from an earlier Veitch map method — which in turn was a development from the logic diagrams of the logician John Venn.

The Karnaugh map is a multicompartment matrix diagram in which every compartment or “cell” corresponds to a specific combination of the variables concerned. A Karnaugh map for four variables is shown in figure 1. Each of the four variables A, B, C and D are regarded as being “true” for the cells indicated by the brackets, and false for the remaining cells. Note that there is a cell for every possible combination of truth or falsity of the variables concerned.

To illustrate the cell coding, the cell “X” in fig. 1 represents the variable combination expressed by

$$X = A.B.\overline{C}.D$$

and the adjacent cell Y represents the combination given by

$$Y = A.B.C.D$$

It may be seen that the cell coding system employed in the Karnaugh map results in the property whereby each cell differs from adjacent cells in the value of only one variable. For example, the cells X and Y above differ only with respect to the value of the variable C. This property simplifies cell grouping, as will be seen in a moment.

Examples of Karnaugh maps for other numbers of variables are shown in figure 2. A two-variable map is shown purely for illustration; in fact, a map would never be required where only two variables were involved. Note that for five variables it proves convenient to draw the map in two matrices, one for each value of the fifth variable (E).

Karnaugh maps for the topological representation of two-and five variable logical functions. Below is a four-variable map marked for the example discussed in the text.

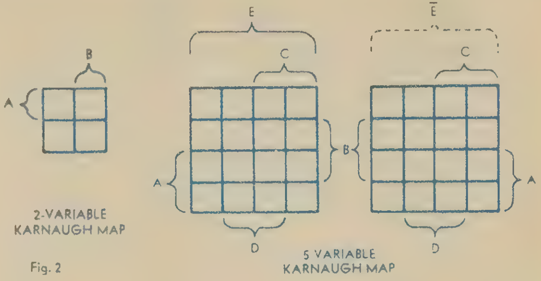


Fig. 2

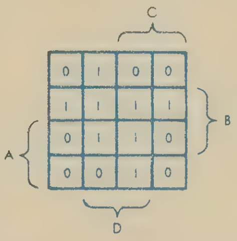


Fig. 3

In using the Karnaugh map to find the prime implicants the first step is to write down in full the logic equation of the complex function, by stating all the input variable combinations for which the output is to be true. For example, a problem may require the output (Z) to be true for the following combinations of four input variables A, B, C and D:

$$\begin{aligned}Z = {} & A.B.C.D. + A.\overline{B}.C.D. + A.B.\overline{C}.D. \\ & + \overline{A}.B.C.\overline{D}. + \overline{A}.B.C.D. + \overline{A}.B.\overline{C}.D. \\ & + \overline{A}.B.\overline{C.D}. + \overline{A.B.C}.D. \quad . \; . \; . \; (3)\end{aligned}$$

In other words, the output Z is required to be true whenever there occurs any one or more of the input variable combinations “(A and B and C and D)”, or “(A and not-B and C and D)”, or“(A and B and not-C and D)”, or . . .

This information is then entered into the map by marking each cell with a “1” or a “0” to signify the required **output value** for that combination of variables. Figure 3 shows a four-variable map with the cells marked for the above example.

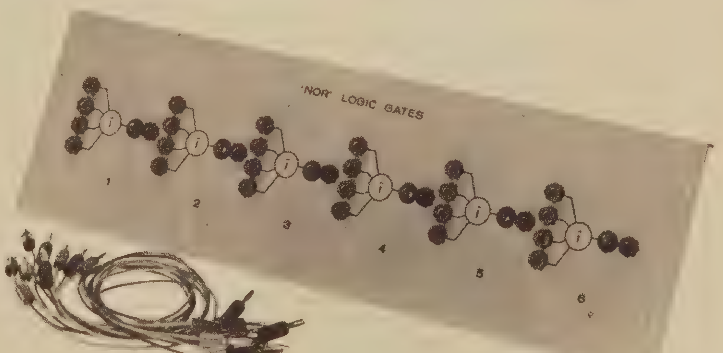
The minimalisation technique then consists of attempting to group all the “1” cells into a minimum number of groups representing small sub-functions in which one or more variables are redundant.

It may be recalled from the first article that a variable is redundant for a particular function if it may take either value without having an effect upon the value of that function.

Thus if a problem required that the output Z be true only for the two input variable combinations represented by the cells marked “X” and “Y” in figure 1, this would mean that input variable C could be ignored as redundant: it can obviously be either true of false as far as that particular problem is concerned. One could thus define the function of the required logic circuit as “Z=A.B.D”.

It may be noted in passing that instead of grouping the “1” cells, it is quite feasible to think in terms of complements and group the “0” cells instead. In fact this alternative procedure may in some cases allow the designer to arrive at a simpler and more satisfactory solution.

To return to the example of figure 3: three of the possible groupings for this map are shown in figure 4 to show



Although the six logic elements on this panel are nominally labelled “NOR” gates, they may in fact be arranged to perform any of the five basic logical functions. The panel is the first of a small group to be described in these articles, intended either for individual use or for eventual assembly into a digital “demonstrator” and breadboarding unit.

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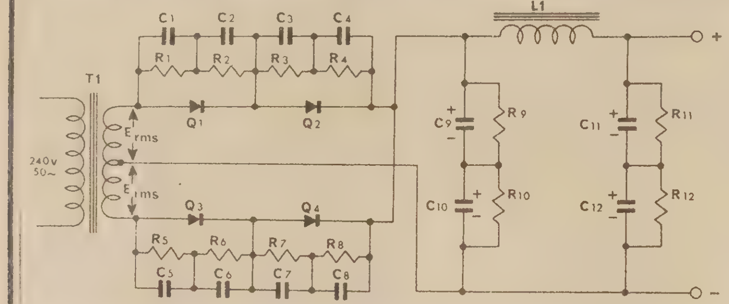

C1-C8	.0022 ufd 600 V.W.
C9-C12	64 ufd 350 V.W.
R1-R8	270K ohm ½ Watt Carbon
R9-R12	25K ohm 5 Watt Wire Wound
L1	5 Henry Choke (Ferguson CF113, A & R 3047, Trimax TZ467)
T1	350-0-350 V at 200 MA A & R PT1938 VO=490 V.DC 180 MA 385-0-385 V at 250 MA Ferguson PF171 VO=500 V.DC 230 MA 400-0-400 V at 250 MA Trimax TP4327 VO=520 V.DC 230 MA
Q1-Q4	Anodeon IN3196 800 PIV Rectifiers

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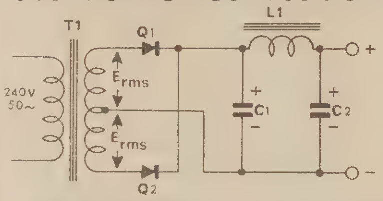

C1-C2	64 ufd 525 V.W.
L1	12 Henry 150 MA (Ferguson CF108, A & R 3042, Trimax TZ465
T1	250-0-250 V at 150 MA (Ferguson PF1508, A & R PT1896)
Q1-Q2	Anodeon 1N3196 800 PIV Rectifiers

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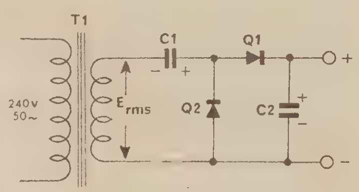
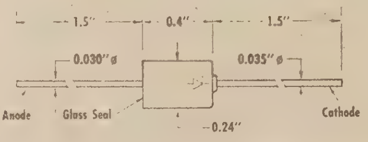


C1	100 ufd 50 V.W.
C2	100 ufd 100 V.W.
T1	18.9 V RMS Three 6.3 V Heater Windings in series
Q1-Q2	Anodeon AD100 100 PIV Rectifiers



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Maximum RMS supply voltage		V	35*	70*	140*	210*	280*	350*
D.F. Forward current	at 25°C	MA	500*	500*	500*	500*	500*	500*
	at 75°C	MA	500*	500*	500*	500*	500*	500*
Recurrent surge current		A	6	6	6	6	6	6
One cycle surge current (50 cps)		A	35	35	35	35	35	35
Max. Forward voltage drop at 500 mA		V	1	1	1	1	1	1
Max. rev. current at rated PIV and 25°C		UA	5	5	5	5	5	5
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Thus from a purely logical viewpoint, the three groupings shown in figure 4 at marked (c) would be most preferble, because it reduces the function Z equation (3) into only four subnctions involving the smallest number terms and their complements: two the four sub-functions involve only o terms, and only terms A and C e required in complementary form. owever, in a practical case some of e factors mentioned above may make roupings (a) or (b) more attractive.

The general rule for cell grouping is first select any cell which cannot e grouped with others. Then "groups f two" loops are made around all cells hich cannot be grouped into larger ops; then "groups of four" loops round those that cannot be grouped to loops of eight, and so on. (Note at it is only feasible to group cells loops enclosing numbers equal to ositive integral powers of two—i.e., ops of 2, 4, 8, 16, etc. This follows om the fact that grouping relies upon ariable redundancy.)

It should be realised that cells on pposite edges of the matrix are effecvely adjacent. Thus a loop may in act contain cells on opposite "sides" f the map, because in theory the map as no "sides." The example in figure 5 llustrates a loop of this type.

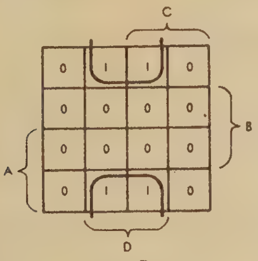


Fig. 5 $Z = \bar{B}.D$

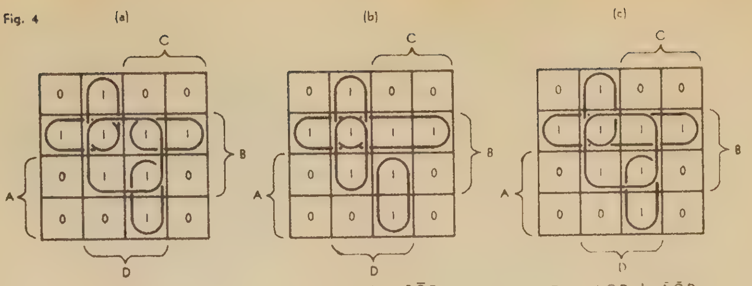
It may be seen that the Karnaugh nap method allows one to determine airly easily the various possible simpliications of the required complex logic unction. This allows the selection of he most attractive of these before ranslating the logical function into ircuitry.

Let us now pass on from this introluctory discussion of logic circuitry to ook at the actual circuitry involved in erforming the elementary logic operaions AND, OR, NOT, NOR and NAND: the circuit blocks or "gates."

There are a great many different ypes of circuit used to realise these operations, and it will not be possible here to describe even a majority of these in any detail. However, it may be of interest to give brief mention of a number of common types of circuit, as follows:

DIODE LOGIC: This is perhaps the simplest type, using semi-conductor diodes and resistors to perform the logical operations and transistor amplifiers to restore signal level. Can attain very high speeds of operation. Often abbreviated to "DL." Sample AND and OR gates are shown in figure 6.

Fig. 4



$Z = A.C.D + \bar{A}.B.\bar{C} + \bar{A}.B.C + \bar{A}.\bar{C}.D + B.D$

$Z = A.C.D + B.\bar{C}.D + \bar{A}.\bar{C}.D + \bar{A}.B$

$Z = A.C.D + \bar{A}.\bar{C}.D + \bar{A}.B + B.D$

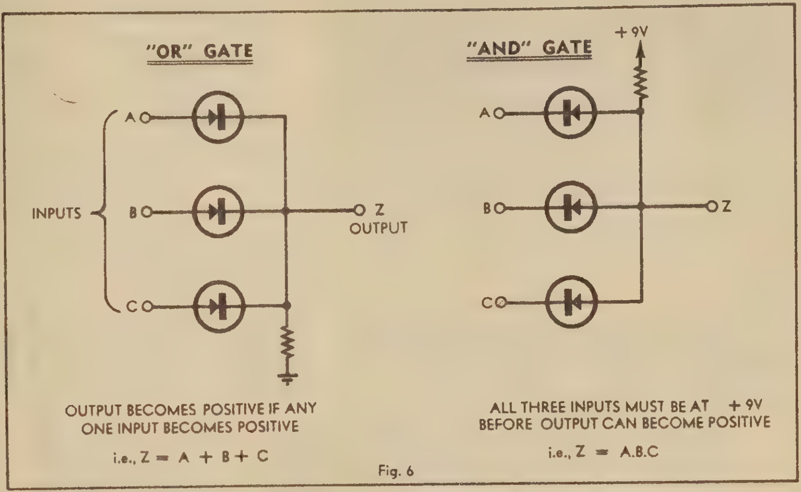

"OR" GATE
"AND" GATE
+9V
A
B
C
INPUTS
Z
OUTPUT
A
B
C
Z
OUTPUT BECOMES POSITIVE IF ANY ONE INPUT BECOMES POSITIVE
i.e., Z = A + B + C
ALL THREE INPUTS MUST BE AT +9V BEFORE OUTPUT CAN BECOME POSITIVE
i.e., Z = A.B.C

Fig. 6

TUNNEL DIODE LOGIC: Not much more complex than ordinary diode logic, but employs the unique characteristics of the tunnel diode to achieve extremely fast operating speeds. Often abbreviated to "TDL."

NEON LOGIC: Uses neon bulbs or three-element neon trigger tubes to perform logic, again in conjunction with resistors. Offers cheapness where operating speeds are relatively low; not suitable for very high speeds. Abbreviated to "NL."

CORE DIODE LOGIC: Logic is performed by semiconductor diodes and small ferrite toroidal cores. For moderate speeds and moderate power levels. Abbreviated to "CDL."

4-LAYER DEVICE LOGIC: Uses thyristors (SCRs) or silicon-controlled switches to perform the logic operations. Mainly used where high currents and/or voltages must be used — "power logic."

DIRECT COUPLED TRANSISTOR LOGIC: Uses transistors switching between bottomed (saturated) and cutoff states to perform logic; depends upon use of transistors with carefully controlled parameters. Economical but tends to be susceptible to noise because of the low voltage levels employed; moderately fast. Abbreviated to "DCTL."

CURRENT MODE LOGIC: Uses transistors to perform logic, but biasing is from constant-current sources to prevent saturation and allow extremely rapid switching. Has high noise immunity despite fairly low voltage levels. A relatively recent system, growing in popularity. Abbreviated to "CML."

DIODE TRANSISTOR LOGIC: Uses diodes to perform the logic, with transistors for inversion and amplification. Virtually an extension of simple diode logic. Capable of high speed operation at moderate cost. Abbreviated to "DTL."

RESISTOR TRANSISTOR LOGIC: Perhaps the most straightforward and economical system where moderate speeds of operation are required. The resistors perform the logic, with the transistors performing inversion and amplification. The use of silicon transistors gives good temperature independance, circuit simplicity and reliability. Abbreviated to "RTL" or to "RCTL" where capacitors are added to give a marginal increase in operating speed.

RTL circuitry will be used in the following short discussion to illustrate the concept of "logic polarity."

In electrical logic circuitry it is usual to arrange for each section of the circuit to have only two stable states, and to make these states correspond to the logical values "true" (1) and "false" (0). This is done because it means that the circuitry can be of a relatively simple "on-off" type which renders operation almost completely independent of component ageing, noise, supply voltage variations and other factors which would tend to be troublesome in multi-state or continuous-variation circuitry.

While the two circuit states used may correspond to such conditions as the "open" and "closed" state of switch or relay contacts, in general they correspond to different voltage or potential levels.

In so-called "positive logic" circuitry, the true or 1 state of the circuit corresponds to a **more positive potential** than the false or 0 state. With a positive

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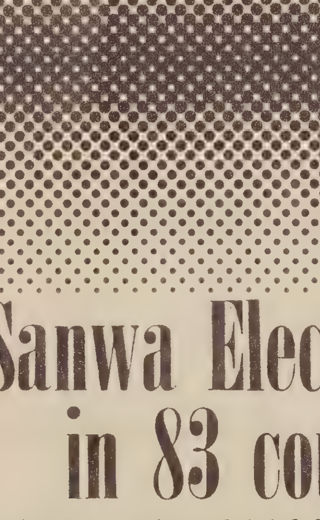

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Dempa Bldg., 2-chome, Sotokanda, Chiyoda-ku, Tokyo, Japan. Cable: "SANWAMETER TOKYO" ipply line and negative chassis or round," positive logic circuitry thus nploys near-supply potential to signify 1" and near-chassis potential to signify)". However a circuit with a negative ipply line and postive chassis may ill use positive logic, this time by using ear-chassis potential to signify "1" and ear-supply potential to signify "0."

So-called "negative logic" circuitry dopts precisely opposite conventions: e **more negative potential** in the circuit represents the "1" state, and the nore positive the "0" state. Again the ogic polarity is quite independent of he actual power supply polarity to the ircuit and it is quite feasible to have negative logic circuit with a positive upply line.

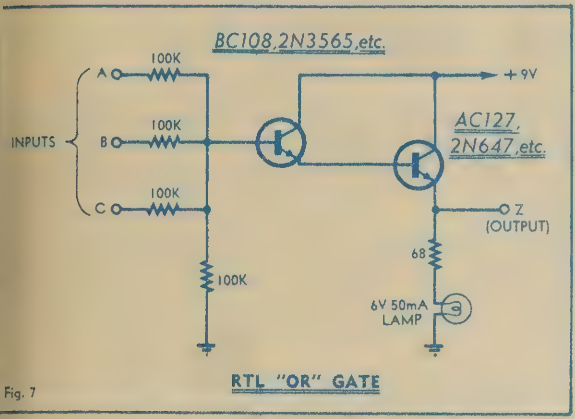

Fig. 7

RTL "OR" GATE

A practical circuit which in positive logic performs the OR function.

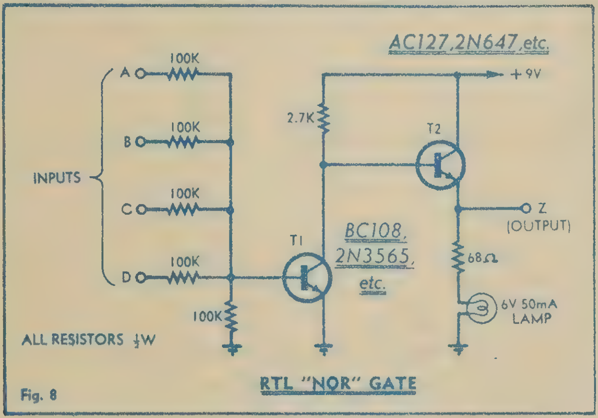

Fig. 8

RTL "NOR" GATE

In positive logic this circuit performs the NOR function. It is used for the gates of the demonstrator panel described in the text.

As mentioned earlier in this article, he fact that it is electrically possible o have both "positive" and "negative" ogic circuitry means that very often ircuit blocks can be made redundant imply by alternating when convenient between one logic polarity and the other. For instance, a NOT operation can be provided simply by reversing the logic polarity rather than by using a physical nverter block. Control of logic polarity is an important part of the technique of minimalisation.

Changes in logic polarity need not necessarily occur at the circuit block interconnections. It often proves convenient to use one polarity convention at the input of a block and the other at the output, virtually reversing the conventions within the block. This technique is called "mixed logic." The first of our practical examples should make these points clear.

The diagram of figure 7 shows a simple transistor circuit which **in positive logic** performs the OR operation. Application of a +9V input signal to any of the three input terminals A, B or C will cause the transistors to turn on. This will raise the potential of the output terminal Z to approximately +9V, and also cause the small indicator lamp to light. I.e., in positive logic terms

$$Z=A+B+C \qquad \ldots (4)$$

The same circuit becomes an AND block or "gate" if we consider it from the negative logic viewpoint. The output Z will then be true (chassis potential) only when all three inputs A, B and C are true also. This in negative logic terms the same circuit performs the operation

$$Z=A.B.C \qquad \ldots (5)$$

(However note that in this case the indicator lamp will signify the false output condition rather than the true output condition.)

From a mixed logic viewpoint the circuit fairly obviously has two possibilities: positive at input with negative at output, or vice-versa.

If the positive-negative convention is adopted ("1"=9V at the inputs, and 0V at the output), then the circuit performs the NOR operation: the output is true only when all three inputs are false. That is,

$$Z=\overline{A+B+C} \qquad \ldots (6)$$

(As with the negative logic case, the indicator lamp will now indicate not "Z=1," but "Z=0.")

And if the negative-positive convention is adopted ("1"=0V at inputs, +9V at output) the circuit then performs the NAND operation: the output is false only when all three inputs are true. Here

$$Z=\overline{A.B.C} \qquad \ldots (7)$$

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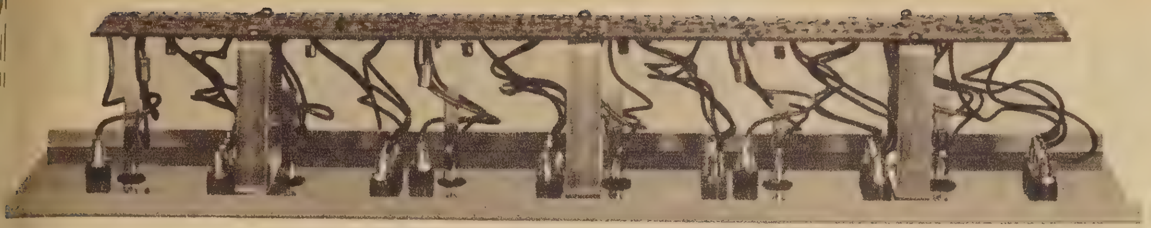
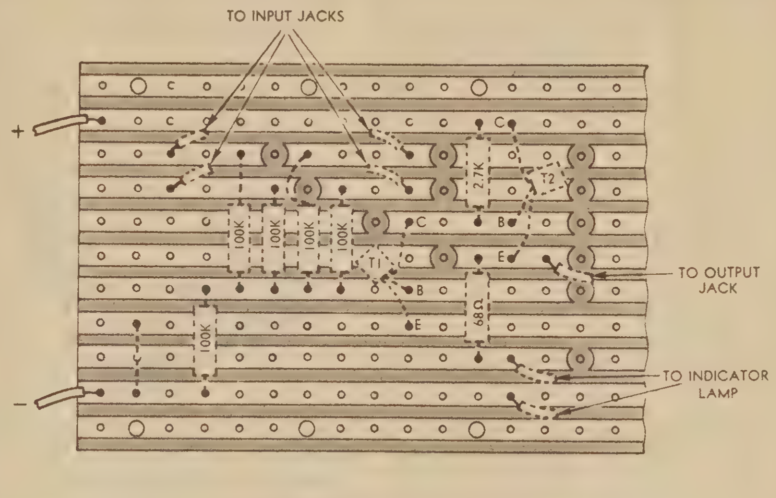
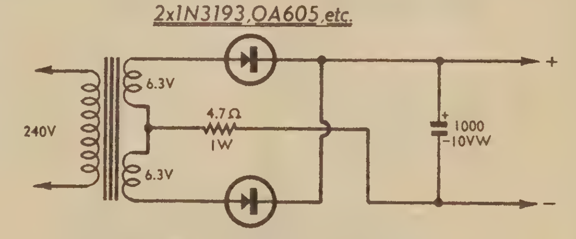


A side view of the NOR gate demonstrator panel, showing its construction. The six gates are wired on "Vero-board" as shown by the diagram below. Three small brackets fasten the board to the front panel, which is from the "Lektrokit" range.



WIRING FOR ONE "NOR" GATE

A small power supply which is suitable for operation of the NOR gate panel. Other power supplies may be used if desired.



POWER SUPPLY FOR SIX OR LESS "NOR" GATES

Depending upon the logic polarity opted, then, a circuit may be used a variety of logical operations. Al- ough the simple configuration shown fig. 7 would commonly be called an R gate, it should always be borne in nd that it is potentially equally suit- le for use as an AND, NOR or NAND te. And, in fact, as a NOT gate as ll—since NOT is logically equivalent either NOR or NAND with a single put.

This property is in fact true of all gic circuitry. As the more perceptive aders will no doubt have realised al- ady, it is simply a practical implication deMorgan's theorem of duality which e discussed in the first article.

Thus the circuit of figure 8 is a NOR te in positive logic, a NAND gate in gative logic, an OR gate in positive- gative mixed logic and an AND gate negative-positive logic. And with only e input, it becomes a NOT gate in ther negative or positive logic.

The "OR" and "NOR" circuits shown figures 7 and 8 are quite practical es, and are well suited for demonstrat- on and experimental purposes by virtue their inbuilt indicating lamps sym- lising "true" output with positive out- t logic polarity. They offer fairly high put impedance (100K) and quite low utput impedance, at a modest cost.

The circuit of figure 8 being a "NOR" ate is particularly suitable for this urpose. For demonstration and experi- ental work a number of these circuits an be built up as "building bricks" to e interconnected as required. Up to ve inputs may be used per gate, al- ough only four are shown in the dia- ram. The basic circuit has been designed or low speed operation, but will op- rate to above 20 KC quite reliably.

Shown in the photographs is a demon- rator panel which will be briefly des- ribed. The panel mounts six of the OR gates shown in figure 8, with their put and output jacks and indicator mps brought out conveniently to the ont. Such a unit would be ideal for emonstrational work, while engineers ay also find one or two such panels seful to mock up or "breadboard" logic rcuitry prior to the purchase of com- ercial circuit modules.

Interested readers may also care to ild up units in order to make them- lves more familiar with practical cir- it logic design and operation.

It may be noted that this panel with s six NOR gates is the first of a small umber of digital demonstration panels be described in these articles. Al- ough most of the panels will be in- ividually useful in their own right, they ill be designed so that they may be sed in conjunction with one another required. It is anticipated that the mplete range of panels will form a gital demonstrator/experimental test- ed of considerable flexibility.

As may be seen from the photographs the gates themselves are wired on a length of "Vero-board" printed conductor strip panel measuring 14½in x 2¼in and having holes spaced on 0.2in centres. The strip is cut from a stock Vero-board panel coded 4/1001, and the conductors cut and wired as shown in the wiring diagram.

The wiring board is mounted to the front panel via three small "U"-shaped brackets bent up from scrap aluminium (8in x ½in strips). The brackets are clamped to the front panel via three of the "output" banana-type jacks. The front panel itself is from the well-known "Lektrokit" range, being coded type LK-401. (Both Vero-board and Lektrokit components are obtainable via parts suppliers, on order from the various branches or agents of the importers, E.M.I. (Australia) Ltd. In N.S.W. orders may be placed with the State distributor, Watkin Wynne Pty. Ltd., of P.O. Box 318, Crows Nest.)

The lamp bulbs used in the unit are of the "No. 2 Telephone Switchboard" variety, being rated at either 40 or 50mA and 6V. They are mounted to the front panel via close-fitting 5/16in rubber grommets.

Because of the indicator lamps the current drain of each NOR gate is approximately 50mA; a little high for battery operation. However quite a few of these units may be powered from a 9V power supply of the simple transformer-rectifier type shown, or from a protected and regulated supply of the type described in the author's article of September 1964.

Note that the gates on this panel have common positive and negative supply rails, and that with positive logic a "true" input to any gate is achieved by connecting one of the four input jacks to the positive rail. With negative logic (where the gates become NAND gates) a true input is achieved by connecting

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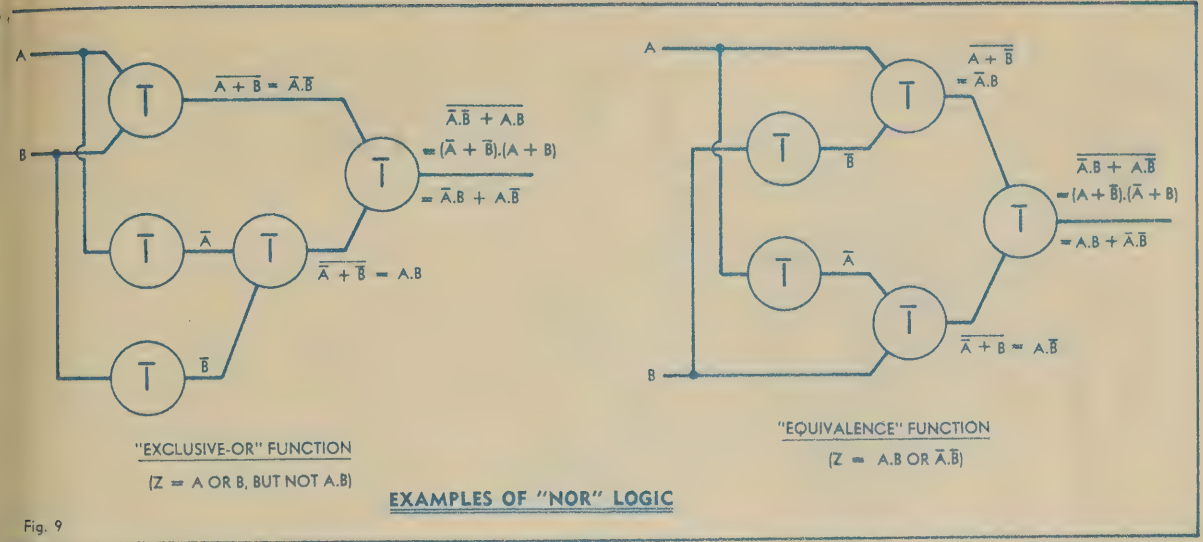

A
B
$\overline{A+B} = \bar{A}.\bar{B}$
$\overline{\bar{A}.\bar{B} + A.B}$
$= (\bar{A}+\bar{B}).(A+B)$
$= \bar{A}.B + A.\bar{B}$
$\bar{A}$
$\bar{B}$
$\overline{\bar{A}+\bar{B}} = A.B$
"EXCLUSIVE-OR" FUNCTION
(Z = A OR B, BUT NOT A.B)
$\overline{A+\bar{B}}$
$= \bar{A}.B$
$\overline{\bar{A}.B + A.\bar{B}}$
$= (A+\bar{B}).(\bar{A}+B)$
$= A.B + \bar{A}.\bar{B}$
$\overline{\bar{A}+B} = A.\bar{B}$
"EQUIVALENCE" FUNCTION
(Z = A.B OR $\bar{A}.\bar{B}$)

EXAMPLES OF "NOR" LOGIC

Fig. 9

Two of the many logical functions which can be synthesised using the six gates on the demonstrator panel. They can also be used to demonstrate the operation of the "flip-flop," and for readout.

n input to the negative rail. And simirly with the two types of mixed logic, here the gates become either OR or ND gates.

The six gates provided on this panel ay be used to demonstrate quite a rge number of logical principles, and mock up many interesting logic unctions.

Figure 9 shows two sample logic unctions which may be used to show unction synthesis, the "exclusive-OR" unction and the "equivalence" function. Many others will be found in the standard texts and in some of the books isted in the bibliography. Note that any NOR gate may be used to perform the NOT or inversion operation simply by gnoring all but one of its inputs.

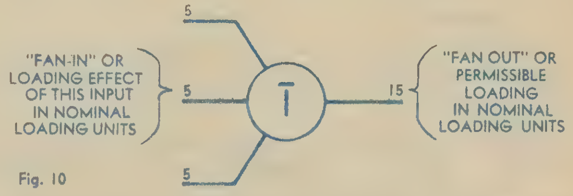
Following articles in this series will how how the NOR gates described may lso be used to demonstrate the operaion of the "flip-flop" and the freeunning multivibrator. They will also be sed as readout circuits in conjunction with the circuitry on the other panels.

To conclude the present article let us ook briefly at the commercial equivaents of the logic gates which have just been discussed.

Commercial logic "building blocks" are usually based on either NOR or NAND units, although most manufacturers provide a wide variety of associted "blocks" in addition to the basic gate blocks. Usually there are "flip-flop" blocks used for storage and counting, Schmitt trigger blocks for waveform conversion and pulse re-shaping, amplifiers to restore signal level, one-shot multivibrators for pulse delaying, and so on. Many of these will be discussed in later articles.

Commercial blocks are of two general types. Where extreme compactness is not required, the "discrete component" type are usually used, consisting of the appropriate resistors, transistors, diodes and so on—wired up and typically encapsulated or "potted" into a protective epoxy resin block.

Illustrated are typical blocks of this type, the "Series 1" digital circuit blocks marketed by Mullard-Australia Pty. Ltd. Operated at speeds up to 100KC, they are intended for use in industrial logic applications, low-speed computers, test equipment, medical electronics and similar applications. The blocks measure 54mM x 24mM x 10mM, and consist of


"FAN-IN" OR LOADING EFFECT OF THIS INPUT IN NOMINAL LOADING UNITS
5
5
5
15
"FAN OUT" OR PERMISSIBLE LOADING IN NOMINAL LOADING UNITS

Explanation of the loading terms "fan-in" and "fan out."

Fig. 10

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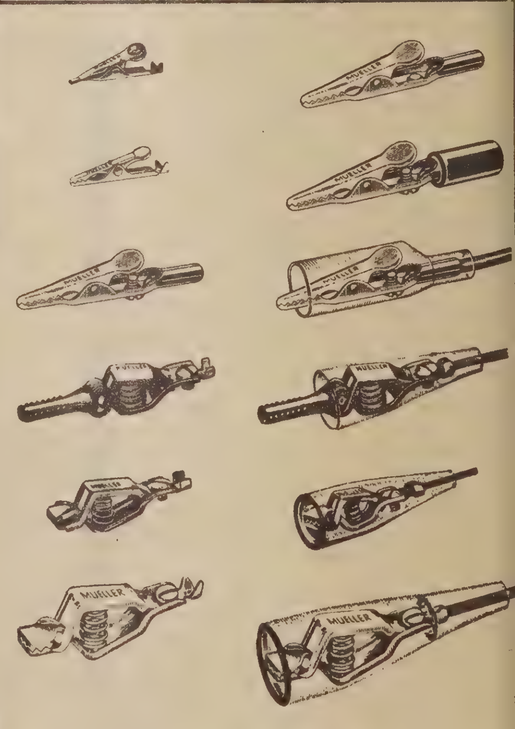
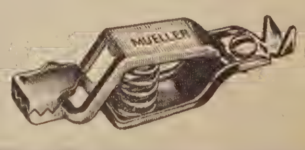


ILLUSTRATIONS ½ ACTUAL SIZE



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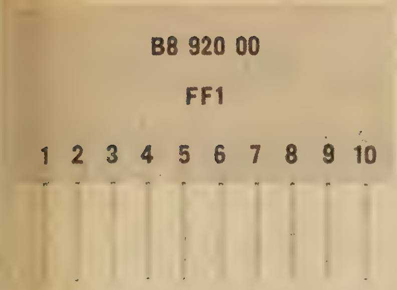


A MULLARD CIRCUIT BLOCK SHOWN ACTUAL SIZE

a small printed board potted in synthetic esin cases; overall weight approximately 20gm. (0.07oz). Operation is from ±6V.

Mullard also make available a range of low-speed blocks for industrial switching applications — the widely-known “Norbits.” As the name suggests, these are based on NOR gates.

Where extreme compactness is essenial, an alternative to discrete-component logic blocks is provided by the more recently developed **integrated microcircuits.**

These consist of the complete circuit for one or (often) more logic blocks, fabricated on a tiny chip of silicon and encapsulated into a package no larger than many transistors. Besides being very economical in terms of space these microcircuit logic blocks are extremely reliable and are ideally suited to fully automated manufacture. For further details on microcircuits, readers may refer to the articles by E. Laisk, M.Sc., in the August and September 1965 issues of “Electronics Australia.”

Pictured are typical integrated microcircuits of this type, samples from the “Micrologic” range manufactured by Fairchild Australia Pty. Ltd. using their patent silicon planar process. At the time of writing, these microcircuits are available in quantities of 1-24 for as little as $2.20, making them quite competitive with equivalent discrete-component circuitry on a cost basis.

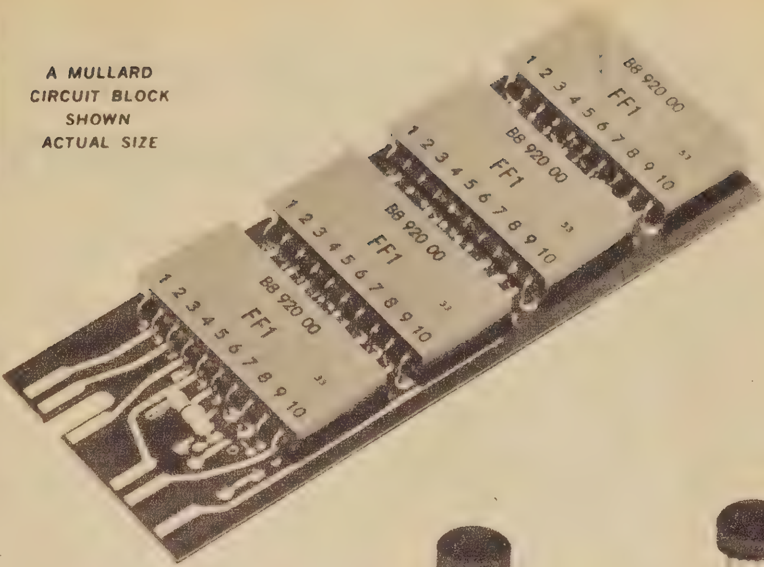
It is common for manufacturers of both discrete-component modules and microcircuits to rate their units in terms of the effective loading of the input (“fan-in”) and the permissible output loading (“fan-out”). Note that fan-in describes the amount the module itself loads the output of the preceding units, while fan-out prescribes the maximum number of units which **may follow** it.

These “loading” and “drive” factors are usually expressed not as voltages, currents or impedances, but in multiples of a nominal loading unit often equal to the loading effect of a single unit.

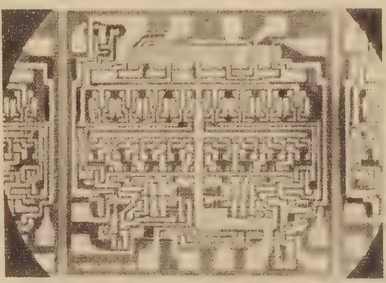
Thus the Fairchild microcircuits pictured are given fan-in and fan-out ratings which are multiples of the nominal loading of a single input of one of their low-power modules — approximately 200uA at 0.9V. An inverter (NOT) unit may thus have a fan-in of “6” with fan out of “80,” showing that it loads a preceding circuit by only 6 loading units but may itself be loaded with modules together requiring 80 loading units.

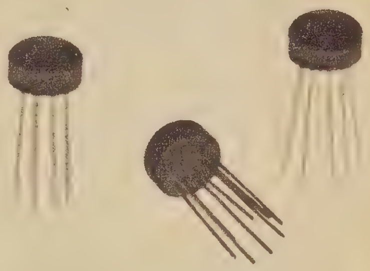
In general, microcircuits operate at fairly low voltage levels and are characterised by low-medium power and high operating speeds. In most cases they employ a modified direct-coupled transistor logic (DCTL). The Fairchild units operate from a nominal supply of +3.6V and are rated to operate reliably at speeds up to 2MC.

(To be continued.)



Four of the Mullard “Series 1” logic blocks mounted on a plug-in wiring board. Actual size of the blocks is shown at upper left. (Blocks courtesy Mullard-Australia Pty. Ltd.)





Fairchild “Micrologic” integrated microcircuits. At left, much enlarged, is the type of circuitry employed in these devices.

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354B	Type 351 with SO 239 coaxial socket.
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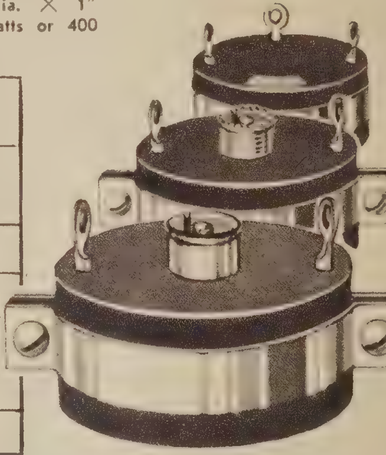

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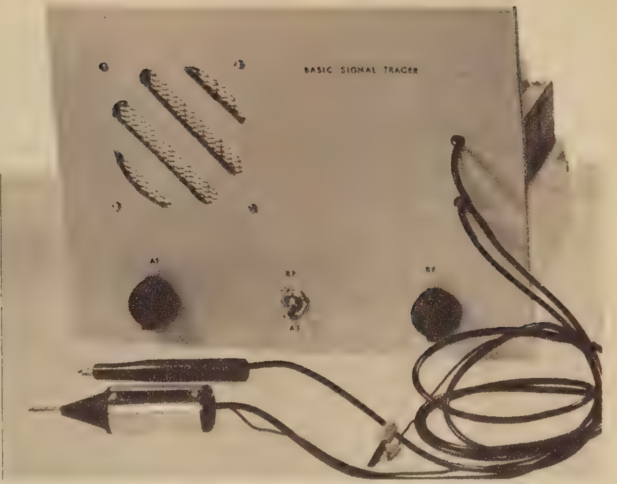


BY KEITH WOODWARD

Designed as a part of our oddment parts construction series, this Signal Tracer is a versatile piece of test equipment. It is no harder to make than previous items in this series, will provide an interesting constructional exercise, and will prove a valuable servicing aid for the beginner and advanced experimenter alike.

The function of this unit is clearly ndicated in its title, that is, it is capable of tracing a signal through a receiver, or audio amplifier, from input to output. At any point along the signal path, an evaluation of the signal quality may be made, and an indication of stage gain obtained.

The simplest form of signal tracer could consist of a pair of headphones with an isolating capacitor in series with one lead. With this device it would be possible to make rough checks on the performance of an audio amplifier at various points and thereby locate a faulty stage.

But such a device would have a limited application. It would work in the audio section only of a complete receiver, and even there would have serious limitations. In many cases it might be too insensitive for the low level signals at the audio input end but, equally, could be too sensitive for the output signal, and would be seriously overloaded.

A further disadvantage is the loading effect of such a tester. Because of the relatively low impedance of its circuit, erroneous results could be produced when the unit was connected to a high impedance point.

This loading effect is one of the most serious disadvantages of many simple tracer designs and limits their usefulness considerably. It can usually be reduced to reasonable proportions by decreasing the coupling between the unit and the tracer, but this, in turn, seriously affects the sensitivity.

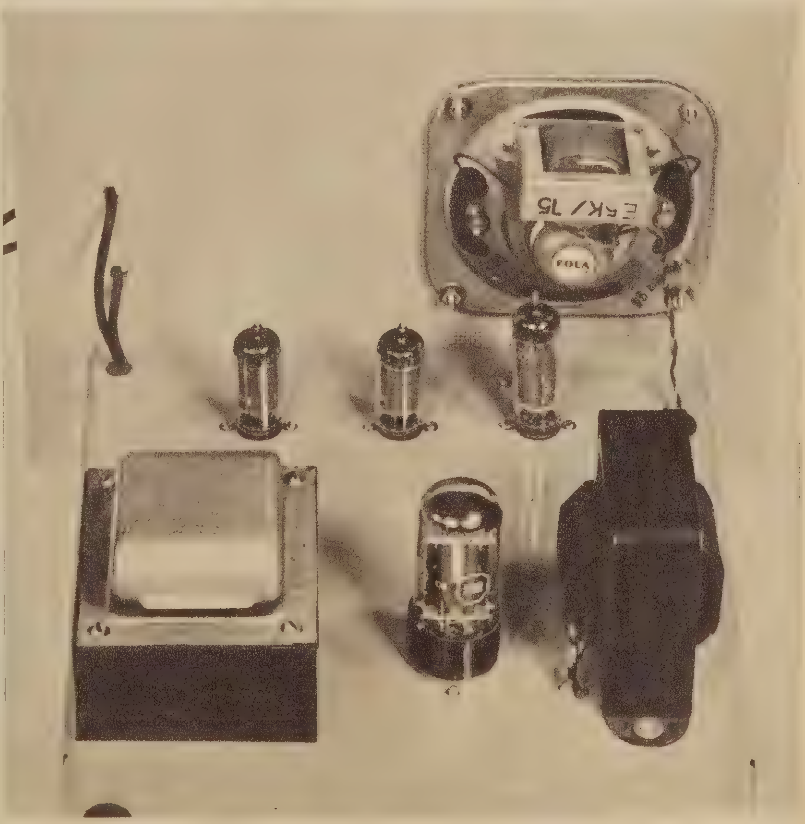
Since adequate sensitivity is equally important, it becomes necessary to provide the highest practical order of amplification, then strike the best possible compromise between minimum coupling — and loading — on the one hand, and maximum sensitivity on the other.

To overcome the other limitation — restriction of usefulness to the audio section — it is necessary to add a detector circuit which will convert either RF or IF signals to audio.

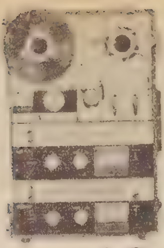
Thus the simplest practical tracer emerges as a high gain audio amplifier, preceded by a detector (the more sensitive the better) and a means of coupling this to the circuit under test with an absolute minimum of loading. To this minimum requirement we can add various minor features such as switches and controls to extend the usefulness of the device.

Further to the requirement of minimum coupling, it is normally necessary to mount the detector circuit in a probe, so that it may be taken right to the circuit under test. Otherwise, if the detector was mounted on the tracer chassis, we would have to couple it to the circuit under test by means of a long shielded cable. This, because of its capacitance, would very seriously attenuate the signals, as well as loading the circuit quite intolerably.

By taking the detector to the circuit, the signal is passed to the tracer in audio



Rear view of the tracer showing the placement of major components. Larger speakers may call for a slightly larger panel.



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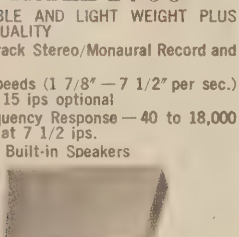

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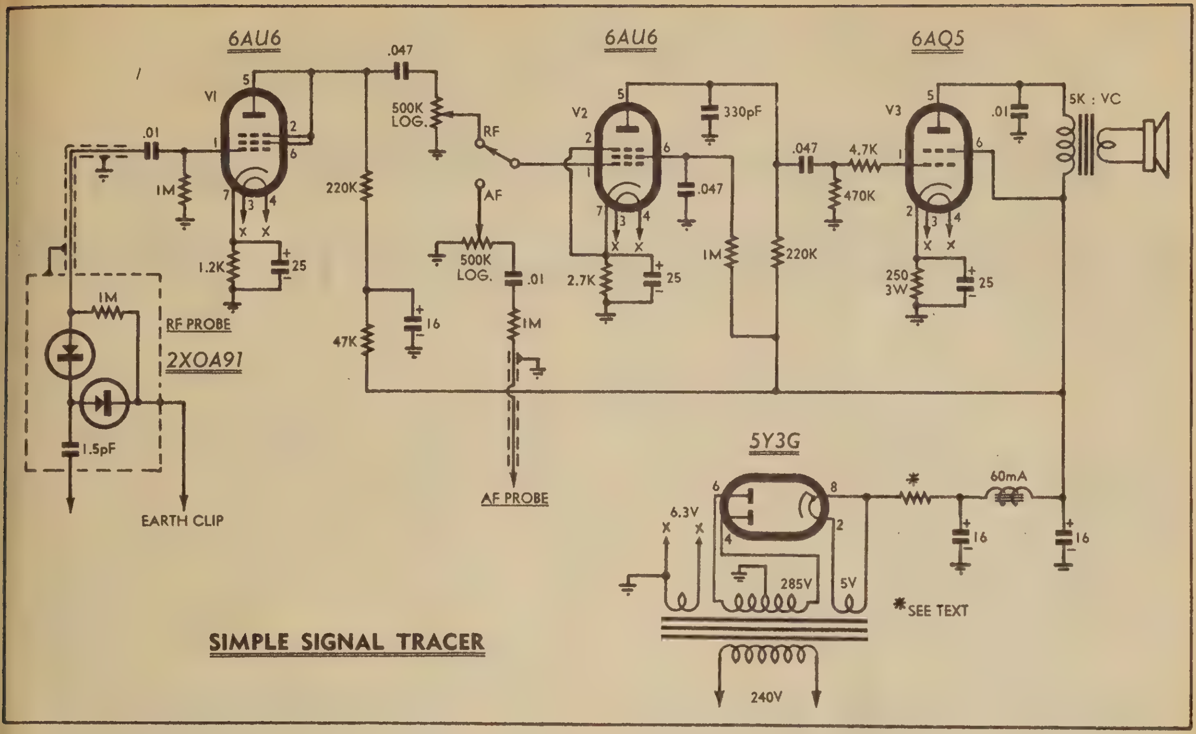
6AU6
.047
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1M
1.2K
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500K LOG.
RF
AF
220K
500K LOG.
.01
1M
47K
16
V2
330pF
.047
2.7K
25
1M
220K
.047
4.7K
470K
V3
.01
5K : VC
250 3W
25
RF PROBE
2XOA91
1M
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EARTH CLIP
AF PROBE
5Y3G
6.3V
285V
5V
60mA
16
16
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The circuit is essentially that of a high gain audio amplifier, preceded by a voltage doubling detector in a separate probe. Note individual gain controls for audio and RF probes.

form, which suffers negligible loss in the shielded cable.

However, this RF probe is not suitable for checking the audio circuits, so a second probe, designed for this purpose and fed into the amplifier at an appropriate point, must be provided.

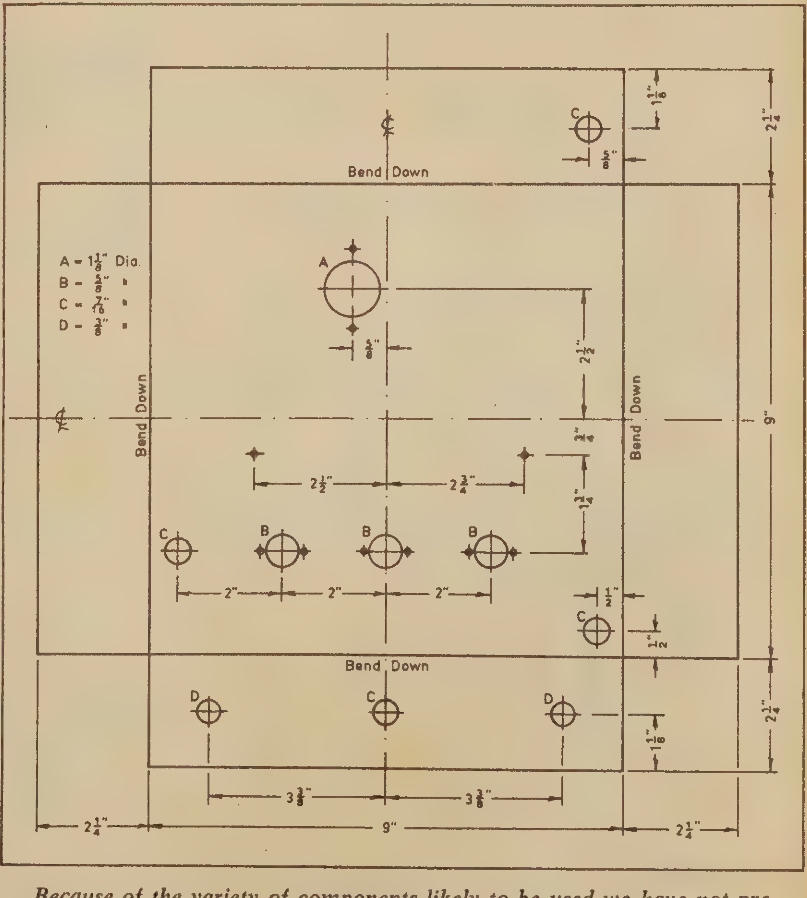
As already explained, it is necessary to provide a high order of amplification in the signal tracer. We suggest a range of 7 pin miniature valves which are most likely to be available in old receivers. Nevertheless, older types could be used; for instance in the octal range such valves as the 6J7, 6SJ7, 6SH7 could be used as replacement for the 6AU6, and the 6AQ5 valve could be replaced by the older 6V6 octal or 6BW6 nine pin miniature.

There are many others but most of them would require changes in the values of components to give satisfactory performance. Those listed above could be used without such changes, the main point being to wire them correctly as per the circuit diagram. Details of pin connections for valves other than those used in our prototype would have to be obtained from a valve manual.

To drive the 6AQ5 we have specified a pentode amplifier stage which gives a high order of gain. This should be sufficient to cope with most audio signals likely to be encountered, so the audio probe is fed in at this point.

Loading of the audio circuits is obviated by the use of a 1 megohm resistor in series with the probe. To avoid overloading the tracer, the input from the probe is fed directly into the audio volume control. Thus, even very high levels of audio may be checked if necessary.

Owing to the much lower levels of recovered audio available from the RF probe, it is necessary to provide an additional stage of audio amplification. We elected to use another 6AU6, wired as a triode, for this stage. This brings the overall gain of the amplifier to about the maximum that can be provided in


A = 1⅛" Dia.
B = ⅝" "
C = 7/16" "
D = ⅜" "
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2¼"
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2½"
9"
¾"
1¼"
2½"
2¾"
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2"
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½"
1½"
2¼"
1⅛"
3⅜"
3⅜"
2¼"
9"
2¼"

Because of the variety of components likely to be used we have not prepared a complete chassis blueprint. However, this drawing shows the placement of major holes and cutouts, which should be made to suit individual requirements.

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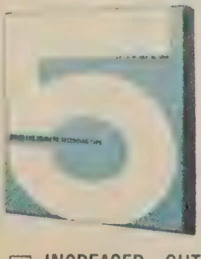

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The RF probe amplifier stage is a ociated with a second volume control. providing a change-over switch in t grid circuit of the 6AU6 pentode, are able to switch it to either volume ntrol. Thus we can connect the unit both the IF (or RF) and audio ends the receiver under test at the same ne. Then, by throwing the switch, we e able to quickly check the perforance of either end of the set.

This facility is extremely useful when ecking a receiver with an intermittent ult. The two probes may be connected, e two volume controls set for comparle volume, and left switched to the dio probe. Should the set fail, a throw the switch will allow an immediate eck of which portion of the receiver at fault.

For the detector probe modern semionductor diodes, with their low cost, nall size, and high efficiency, were an ovious choice. It only remained to lect the most suitable circuit. Initially, e tried a simple half wave arrangeent and, although this worked much as e expected, we were still conscious that ny additional gain we could provide ould be worthwhile. It was a relatively mple matter to wire in an extra diode produce a voltage doubling detector, nd this resulted in a significant improveent in sensitivity.

To keep the loading to a minimum, e settled for a coupling capacitance f 1.5pF which provides a reasonable ompromise between the conflicting actors. Small though this value is, it still as some effect on the circuit under test. hile this effect is minor, and not suffiient to mask the behaviour of the latter, does indicate that any larger value ould probably be intolerable.

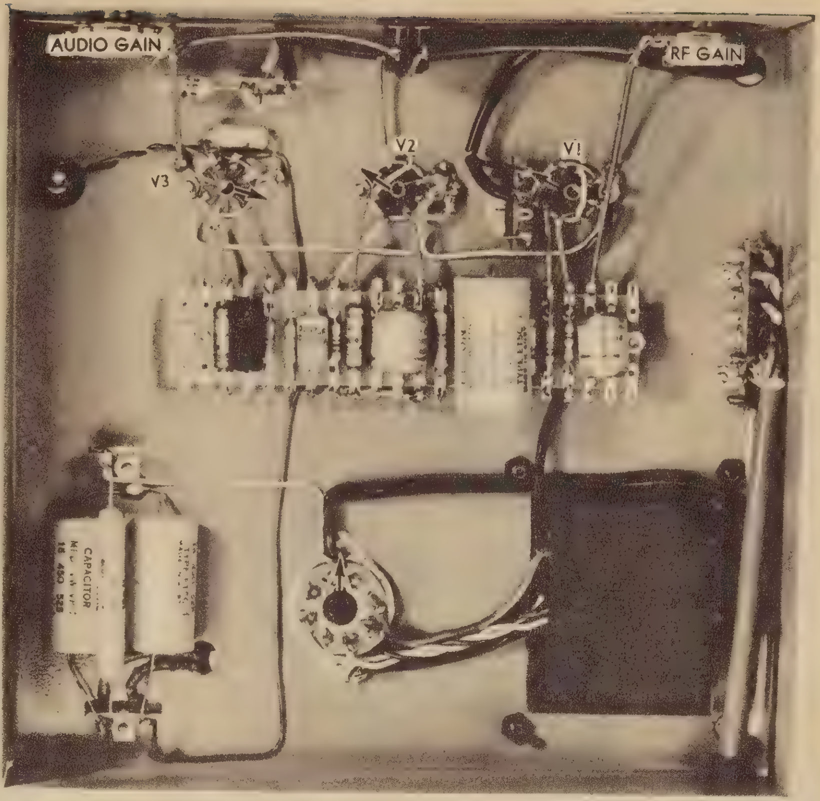
As with most test equipment, the more amiliar the user becomes with perfornance characteristics, the more useful vill be the equipment. Therefore, when he instrument is first built, it is a good dea to check its performance on several eceivers in working condition, making otes, if necessary, of typical volume ontrol settings, etc.

In relatively strong signal strength reas the RF probe is capable of proucing a reasonably strong signal from he converter valve signal grid. A slight mount of detuning may be noticeable when making this test. If the nearest roadcast station is some distance away it may be necessary to inject a signal into the aerial terminal of the receiver with a signal generator, and chase this signal with the signal tracer.

In general, a large number of the parts used in the signal tracer may be salvaged from old receivers. However it is strongly recommended that new electrolytic capacitors be purchased for the project. Old electrolytics may have dried out and cannot be trusted to perform in the desired manner.

Depending on the transformer and filter choke combination used, it may be necessary to add a limiting resistor to the power supply to keep the HT within acceptable limits. The maximum is about 285 volts, dictated by the maximum plate-cathode voltage of the 6AQ5 at 275 volts.

In our prototype, the transformer/filter choke combination produced a voltage marginally on the high side. Since



This picture gives a good idea of the layout. Most of the minor components are accommodated on a terminal strip. See page 59.

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	Input Z:	1 megohm shunted by 20pF max.
X AMPLIFIER:	Sensitivity:	Better than 3V p-p/cm at 1Kc/s
	Response:	1.5c/s to 400Kc/s within -3db
	Input Z:	2.2 megohms approx shunted by 60pF max.
TIME BASE:	Sweep Freq.:	10-100c/s: 100c/s-1Kc/s: 1Kc/s-10Kc/s: 10Kc/s-100Kc/s (Continuously variable between steps)
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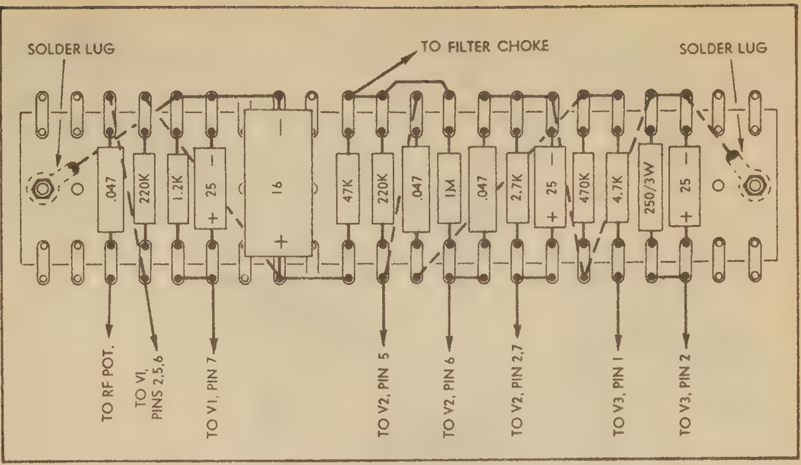
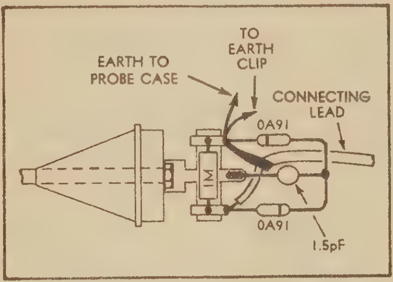


The layout of the terminal strip. This may be wired separately, then dropped into place and the few remaining connections completed.



A detailed drawing of the RF probe assembly.

a resistor had to be fitted anyway, it was decided to aim at a HT of about 260 volts, this providing a safety margin for line voltage variations, some reduction in current drain, less heat, and, possibly, some improvement in valve life. We selected a 100 ohm resistor with a 10 watt rating and this should prove a suitable value for most combinations of 285 volt a side transformers and filter chokes with about 150 ohms DC resistance. Higher voltage transformers will require higher values of resistance and power rating.

Some care should be exercised in the selection of shielded wire for the probes. Some shielded wire has a high capacitance which will introduce losses. If a small diameter coaxial cable designed for RF applications is available this is an excellent choice. When ordering this cable specify a low capacitance cable and if a personal selection is made a cable with a braided shield rather than a spiral shield is preferable. If two cables of similar construction are available the one with a larger diameter of insulation is likely to exhibit the lowest loss. This cable should naturally be flexible and a solid core should be avoided.

The 1 megohm resistor in series with the audio probe has been located on the chassis for wiring convenience. However, if the constructor wished to minimise the effect of the cable capacitance, this resistor may be mounted in the audio probe.

The RF probe requires a longer body, and a Watkin Wynne short probe was selected. A diagram of the wiring used in the probe is given. The metallic body of the probe is connected to the shield of the cable to minimise hum pickup. The short earth lead, fitted with crocodile clip and issuing out of the back of the probe, is also connected at the same point. In use, this clip is connected to the chassis of the circuit under test.

In some measurements, owing to the high sensitivity of this probe and the following amplifier, some hum may be noticed. This can be caused by earth loops and a variation in the point where the earth clip is fastened can sometimes eradicate this trouble. Usually the closer the earth point to the test point the less the hum is likely to be.

The three lug terminal strip used for supporting the components in the RF probe may be a little long as purchased, in which case it will be necessary to carefully file both ends to achieve a neat fit.

We are including a partial chassis diagram with this article giving the centres for valve sockets and other mounting holes. We have not included details for the power transformer and choke as these will have to be cut to suit the components used.

For ease of wiring we elected to mount the majority of the smaller components on one tagstrip. When this tagstrip is pre-wired to the diagram given and dropped onto the chassis very little wiring remains to be done. The only shielded wiring used in this project is that on the two probes, the remainder being either plastic hook-up wire or spaghetti covered tinned copper wire.

In the prototype signal tracer we used a special rubber grommet for the power cord. This grommet resists any slip of the cord when it is pulled. If this type of grommet is not used we suggest that a clamp be fitted to the chassis to anchor the cord and protect the conductors from damage.

The front panel of our unit was fabricated from a piece of Masonite eight inches high and 11 inches across. This accommodated our four inch speaker reasonably well but could constitute a problem for larger speakers. While not as convenient, if a large speaker is used, it may be necessary to mount it on a separate baffle or in a speaker box. In this case the speaker transformer could be mounted on the chassis and the voice coil leads run to the speaker. ▬

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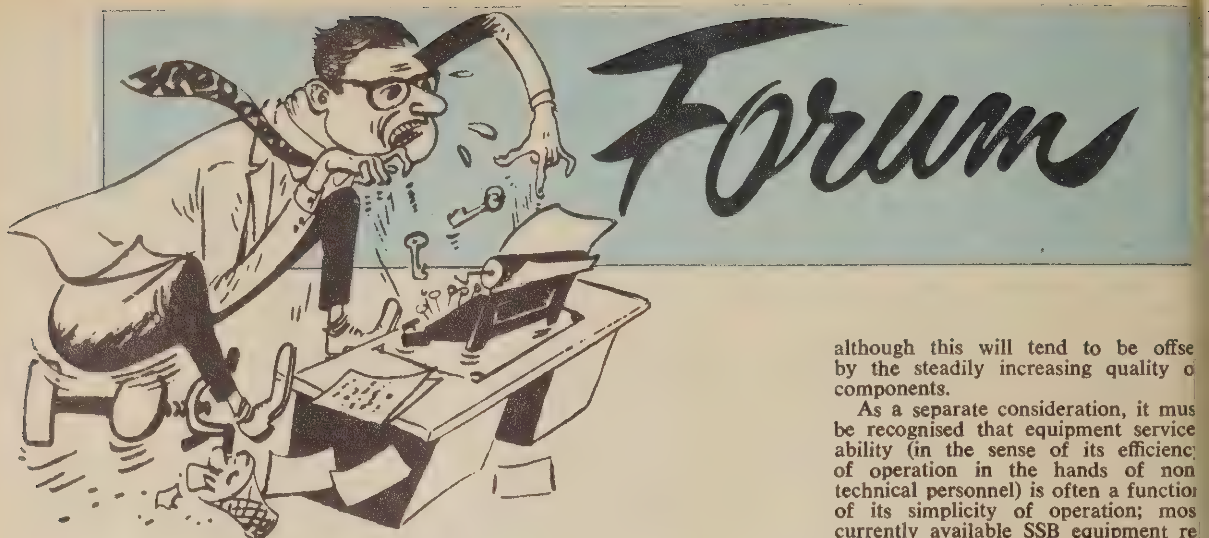

CRITICISM OF SSB ILL-FOUNDED

A letter published on page 79 of our May issue voiced the complaint of a reader who said that he had found SSB (single sideband) equipment to be very unsatisfactory under desert conditions. The letter has raised quite a barrage of protest.

By W. N. Williams

It is not practicable to mention or quote everybody who made comment but the letters which follow are fairly representative of reader reaction:

Dear Sir,

Your correspondent J.D. described two pieces of radio equipment which he uses. We don't know the unfortunate manufacturer of his SSB equipment but his AM set is almost certainly one of our Type 6104.

To set the record straight, we would like to make some corrections to his very kind account. The dimensions of the transceiver are 11 x 4¼ x 8 inches. The weight is 10lbs; the battery drain on 12V DC is not 100 watts, but under 40 watts.

We spent some time in the design of the unit, and it is intended to be used by the most unskilled under the most adverse conditions, into almost any aerial which might present itself. The transceiver is not perfect — we know that ourselves — but there are over 330 of them in service, mainly with inland radio services. Users tell us that they are satisfied with them.

One final point — the cost is $260 plus $20 per channel (i.e. complete transmit/receive facility) fitted.

May I also comment on J.D.'s difficulties with SSB?

It seems that his main trouble is that his equipment has been designed for entirely different conditions, most likely the designer envisaged his equipment being used where mains power was available, probably in an air-conditioned atmosphere (certainly a clean one) and at a fixed location.

J.D.'s situation is an almost classical example of the mis-application of equipment designed for a specific job. In this case it's probably not J.D.'s fault or his Company's. They were probably told by the P.M.G.'s Department that their licence application for a point-to-point system would be favourably considered if they operated SSB, but not so favourably if they asked to use DSB. In these circumstances the best available at the particular time probably wasn't appropriate.

We find it hard to accept that the RFDS network will go to SSB holus bolus. Many manufacturers have the feeling that SSB will probably be mandatory for NEW services introduced after 1970 but we doubt that the economic burden of replacing the hundreds of transceivers involved could be borne by the pastoral industry — particularly if drought conditions should happen to prevail. It seems likely that an SSB base station might be set up alongside the existing one, with new licences issued only for SSB equipment, and a program of gradual changeover established.

Alternatively, it is conceivable that the P.M.G.'s Department may set up a radio-telephone subscribers system to replace the RFDS network. Such a system now operates from Broken Hill, and the Department has announced that it is to operate another network from Alice Springs. It may be asked, though, whether this system would provide all the services (particularly in respect of portable outposts) which are now available.

Then comes J.D.'s next point regarding equipment price and reliability. SSB equipment will probably always be more expensive than DSB, just because SSB equipment is more complex and there are of necessity more components in an SSB transceiver than there are in a comparable DSB unit. By the same token, reliability will probably decrease as the quantity of components increases, although this will tend to be offse by the steadily increasing quality o components.

As a separate consideration, it mus be recognised that equipment serviceability (in the sense of its efficienc of operation in the hands of non technical personnel) is often a functio of its simplicity of operation; mos currently available SSB equipment requires a fair amount of technica appreciation of the control and tunin functions if it is to operate successfully.

We believe that one reason tha our small DSB unit is so successfu is that control functions can be related to indications given by the equipment, and the user need know n more than this.

Yours faithfully,
I. J. BETTISON, Director,
EILCO (Norwood, S.A.).

This letter is written from the view point of a manufacturer of AM transceivers and who, quite naturally, sees the virtues of his own class of product. However, he is not one-eyed in the matter and concedes that our original correspondent's judgment of SSB equipment has been most unfavourably coloured by experience with units quite unsuited to the environment.

He leaves unanswered the question as to whether more suitable SSB equipment does, in fact, exist but another correspondent dispels any doubt on this score:

Dear Sir,

Let us not condemn SSB by the experience of J.D.

The equipment used was obviously, by its weight, consumption and size either dated or never intended for the use made of it, apparently designed solely for base station operation.

Had J.D. used the time spent in writing his letter to check market availability before acquiring the much maligned equipment, he would have learned that there is available modern silicon equipped transistor transceivers specially designed for SSB operation from at least one Australian manufacturer.

In operation throughout Australia and New Guinea, hundreds of these units are operating in very high temperatures, weigh and consume less power than than their AM equivalents and operate from a 12-volt source of wet or dry batteries.

My sympathy is extended to J.D. but the wound was obviously self-inflicted.

Yours faithfully, E. C. HULME,
(Wagner Industries Pty. Ltd.)

The writer of the next letter, who signed his letter but wishes to remain anonymous, is concerned with practical use of SSB equipment on a quite large le — apparently with every satisfac- n:

Dear Sir,

J.D.'s letter on SSB equipment in he desert (ELECTRONICS Australia, May, 1966) simply indicates that:

(a) He did not shop around very thoroughly.

(b) The SSB equipment bought for the task was not designed for Australian use, whereas the AM equipment very likely was.

Being concerned in the installation and use of Australian designed and manufactured SSB equipment, which, with 100 watt (PEP) output, weighs far less than any known AM equivalent equipment, has far less 12 volt battery drain, and is designed for Australian conditions, I think J.D.'s outright condemnation of SSB on the basis of his experience with what is obviously a very old fashioned approach to the art, is altogether too superficial.

Yours faithfully,
C.A. (Ermington, N.S.W.)

So much for the original letter by D. and the kind of response that as prompted from other readers.

If I might comment in a general way, might say that there has been a good eal of mumbling about the gradual shift oward the SSB technique in various elds. Some question its necessity; some iink that it's "too hard"; some feel that s technical complexity will operate gainst reliability, compared to the "good ld AM system"; some, I fear, don't like , simply because it's new.

Like it or not, however, we have to ace the situation that more and more adio services are having to be crammed nto the presently usable spectrum pace. This means that they have to perate closer together, in terms of frequency, and be confined to a more imited bandwidth.

Transmitter specifications have to be ightened in terms both of frequency tability and freedom from unwarranted adiation of any kind.

Receivers similarly need a higher order of stability and the capacity to reject owerful signals in adjacent channels. In ddition, they must reject signals that night break through, either as a result of spurious responses in the receiver or a susceptibility to cross-modulation.

Let there be no illusions about the matter. To build transmitters and receivers to operate within ever narrowing frequency limits — and remain commercially competitive — is constantly straining the ingenuity of design and production engineers.

Only this week, a news item came to hand indicating that the Mobile Radio Committee of the British Post Office is contemplating the adoption of 12.5KC spacing for VHF mobile radio services. Despite possible problems, with equipment design, they have to face the fact that there are now some 70,000 mobile equipments in use in Britain and indications are that the number will double within three years.

It is being strongly claimed that, confined to this order of bandwidth, an FM system gives poorer signal resolution than conventional AM, while the FM equipment is harder to make anyway. This could mean the end of a communications era, with FM dropping completely out of the mobile radio field.

But the possibility must be borne strongly in mind that the days of AM

DOESN'T LIKE HIGH-BAND VHF

Dear Sir,

Many people would have heard about the Gippsland Fires of 1965, the pros and cons of actions taken, suitability of equipment, and uses made of it, etc. The Country Fire Authorities' radio communications system and what has transpired since the fires is the reason for this letter. Radio communications for the C.F.A. have consisted of AM transceivers operating in the 2-5MC range and FM transceivers in the VHF bands 70-85 and 156-172MC, using a number of spot frequencies spread throughout these bands. With radio-equipped fire fighting vehicles coming from areas throughout Victoria, lack of ability to communicate between various groups was painfully evident.

Prompted by this lack of co-ordination it was decided to hand over to the P.M.G. the task of formulating a new radio communications system, such that radio-equipped vehicles from any location in Victoria could go to any other place in Victoria and be able to work effectively.

At this point I must digress to describe another action taking place at the same time.

A large proportion of the C.F.A. communications in Victoria has been on the high frequencies but, early in 1965, we were urged by the C.F.A. in our particular area to convert to VHF (70-85MC). The allotted frequency was 77.84MC and, in fact, both this frequency and 2.692MC are still used in this area. Approximately half of the groups are on the 77.84MC and the other half on 2.692MC. The groups on 2.692MC agreed to see how VHF worked and in this general area in Gippsland, results were satisfactory, giving adequate range, base-to-mobile, with few dead spots.

Following experience and company-arranged tests, many groups were prepared to purchase 77.84MC FM gear even though, in general, mobiles cost at least half as much again and base stations over twice as much as comparable HF equipment.

About this time the P.M.G. came forward with the new co-ordinated radio communications system. This system is for VHF high-band FM centred around 163.12MC, using 30KC channel spacing; 5 to 6 channels will be allocated adjacent to one another, to be used throughout Victoria. Mobiles and bases will be multi-channel units, so that radio-equipped vehicles can go to any part of Victoria and still maintain contact with vehicles and base stations indigenous to that area.

This sounds good and is long overdue, but snags soon become apparent — and these are serious.

Groups which were going to buy 77.84MC equipment decided that they had better get tests with the high-band equipment. Tests were run by several companies and the results obtained in some areas were comparable with low-band. BUT, in about half of the areas, the results were decidedly inferior, giving about two thirds of the range and covering half the area, with many dangerous dead spots. These results are just not good enough, particularly for those who happen to live in such areas.

After these first tests, other locations were tried but results have not equalled those on the low-band.

The results so far obtained indicate that extremely high, directional aerials with the base located remotely from the centre of the controlled area could be the answer. The problem here is that the base station would most likely cause interference in adjacent areas. The cost of the high masts and directional aerials, along with the equipment and remote control facilities could easily reach $1600 or more, and this doesn't allow for power line entensions, a building to house the equipment and P.M.G. land-lines. In these circumstances the high-band could easily bc double the cost of the low-band base.

The way that we are being pressured into converting to high-band VHF would seem to indicate that the powers behind this change want us to change quickly, leaving us to find out afterwards that the system doesn't work as claimed. Questions about costs, or how coverage could be improved, have been side-stepped.

A question was asked why it wasn't possible to allocate six channels close together on the 70-85MC band; we were told that the band had no vacant spaces. This I fail to see. The use of 30KC spacing of channels in place of the older 60KC spacing would double the number of available channels and, since the new standard has only been in about a year, I fail to see how the radio population on the band has doubled in 12 months!

Most C.F.A. radio communications networks are still on HF throughout Victoria, and I would advise them to ask as many awkward questions as possible before considering changing over to VHF.

It seems that we are eventually to be forced to buy VHF gear which, to a large extent, is paid for by donations from the public; instead of having to pay $280 for a 25-watt HF mobile they will have to pay $480 for a 25 watt VHF mobile. A HF base station would cost $320-$400, the aerial extra, and a VHF base station from $760 upwards, the aerial, tower and remote control (if necessary) extra. Remote control starts at about $200, towers $100 to $600, aerials start at about $60 and for HF aerials would be about $60.

It would seem that the P.M.G. allocate frequencies and devise policies on a State basis rather than an Australia-wide basis. It certainly would be a good idea if the important services such as fire, police, ambulance, etc. throughout the Commonwealth were better co-ordinated.

I hope some high officials in the P.M.G. read this letter and realise they can't solve many of these problems of communication just with a slide rule and "red tape" methods. They should think of the users' point of view.   *R. C. (Sale, Vic.)*

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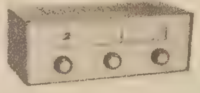

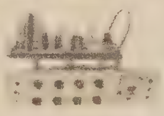

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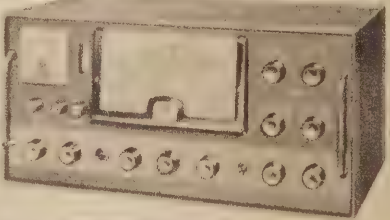

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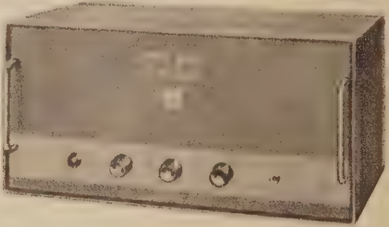

may, themselves, be numbered, except for the less critical installations. There is every reason to believe that SSB techniques can produce a better signal-to-noise ratio with even less band space than AM and that this will be the direction of the next major shift.

How soon it should happen, how soon it will happen and to whom it may happen are all very contentious matters at the moment.

It is already happening on a wide scale in the ranks of the amateurs—and not without some heartburnings. It would seem that, if an amateur wants to work DX on voice, SSB is the way to do it. But SSB equipment is a good deal harder to build and get going than the ordinary AM variety, with the result that an interesting proportion of amateur gear is bought, not built.

Many amateurs deplore this for its own sake but they are also unhappy about the "keeping up with the Jones" attitude that goes along with it. If an amateur comes up with some nice gear by the sweat of his technical brow, that's one thing. If he can outshine everyone else simply as a measure of his wallet, that's another!

Tied up with this the lament, I have heard amateurs comment on the alleged passing—or at least the dimming—of the old spirit of mateship.

One amateur put it to me this way, just recently: "Years ago, a fellow would come on the air with experimental gear and the boys would rally around all right, to help him sort out the bugs. Nowadays half of them tell you to quit mucking about and buy some decent gear like theirs!"

In saying this about amateurs, I know that I've wandered off the path but I've done it deliberately, because it's the same mental track that a good many seem to follow. Amateurs should sort out and separate the three points:

(1) SSB is a technique which may well offer the best solution to the problem of overcrowded frequency bands.

(2) Because SSB is technically more difficult, it offers a challenge which individuals may or may not be able to meet.

(3) If the spirit of on-the-air mateship is diminishing, efforts should be made to restore it at a "human" level, not by criticising a particular circuit technique.

Doubtless, we will be hearing more about all this but, in the meantime, let me refer you to the letter by R.C. under the heading "Doesn't Like High-Band VHF."

May I stress that this letter does not necessarily reflect the opinion of the undersigned on this matter. But it is the sincere opinion of a reader who is apparently involved in the problem of communications related to firefighting in Victorian forests.

He may be right on the ball, in which case his views should be publicised.

He may be right off the ball, in which case his views might, to advantage, be shot down in flames!

One might ask, for example, what groups think of the move who have, on his own statement, been operating on high-band VHF. If it is so poor, did they oppose the move? If not, are they in quite different terrain? And so on.

But just one point: Is he right in blaming the P.M.G. Department for the alleged lack of co-ordination between comparable services in various centres and various States?

I would strongly suspect that the basic cause for most of the diverse practices and diverse frequencies lies with the local and State authorities involved, who tend to pursue certain lines of action (and request licences for same) each convinced that he is doing the logical thing.

It could be that R.C.'s letter is an example of the very thinking which frustrates moves toward rationalisation.

WHY GRUMBLE ABOUT THE CODE?

Dear Sir,

I have been moved to write to you by articles in which there is protest, particularly amongst "Ham" operators, against the necessity of having to read and transmit Morse Code to gain their Amateur Operator's Licence.

Morse is relatively easy to learn, as the Navy has proved time and time again. I myself, a trainee radio operator in the R.A.N., learned to read Morse in four months at a speed of 20 words per minute, attaining nearly 100 per cent accuracy, even when reading random letters grouped together and foreign languages.

If the basis of this outcry against having to learn Morse Code is lack of training facilities, surely amateurs could provide their own.

The advantages of Morse in communications cannot be stressed enough. They have been proved time and time again.

The greater range attainable on a Morse circuit operating on the same frequency and power output as a voice circuit is the most obvious advantage. In times of heavy interference, Morse is by far easier to read than voice and a message would probably be passed a lot faster by Morse than by a voice operator, allowing for repetitions and corrections.

Personally, I feel that if amateur operators' interest in radio communications is as deep as it is supposed to be, there would be none of this rubbish about Morse being too much trouble to learn.

Radio Telegraphy is with us to stay, and those who are too lazy to learn Morse and the commercial procedure for its use, should change their mode of thinking or forget altogether about being radio communications operators.

Yours faithfully,

N.T. (Westernport, Vic.)

Valve Data

Dear Sir,

Concerning the complaint from, and the reply to, your medico correspondent, I think you rather missed the point.

As I see it, W.N.'s main complaint is that (1) There are no readily available published valve data. (2) By inference he suggests valve makers should take a leaf from the drug houses' book and include a leaflet with each valve.

Surely you missed the oportunity for criticising the many wild statements concerning the valve maker, including: "He is determined to make it as difficult as possible for anyone to obtain the information needed to make that valve give its optimum performance." Perhaps this was intentional, so I may be allowed a few comments.

You don't need me to remind you that in those far-off days when the radio world was young, valve makers did include a leaflet with every valve sold, giving details of characteristics and recommendation as to its use. Why? Because the sole users were amateurs (not necessarily hams) and valve data books were unheard of.

As the pattern of events changed, culminating in the American radio boom of the late twenties, receiver manufacturers became the main users of valves. Then, with the passing of time, the replacement market developed which meant that together the two outlets for production accounted for most of the factory output.

In the circumstances it would have been, and still is, redundant to include data sheets with every valve sold, especially when a large proportion of valves is not even packed in cartons but supplied to manufacturers in "egg crates."

For our doctor friend to draw comparisons between drugs supplied to the medical profession and valves being sold over the counter is only confusing the issue. Surely he must realise that the hobbyist who inadvisedly decides to substitute a different type of valve ("jam it into the socket in the blind hope that the pins will match the internal connections of the valve") is doing something which, in medical circles, would be condemned as self-medication.

Furthermore the allegation that valve makers make things difficult (presumably for the hobbyist) by deliberately withholding technical data is both untrue and an inept comparison. It would be just as logical if the doctor's patient were to complain that the doctor does not provide him (the patient) with pharmaceutical details of every prescription issued.

When the layman requires medication he relies on an expert, the doctor, to prescribe the appropriate drug. So it should be in the field of electronics. The expert, the engineer, decides on the most suitable type of valve for a particular application and, if his choice is sound, nothing can be gained by anyone trying to "improve" things by attempting to substitute a different type of valve.

In conclusion, may I suggest that if W.N. really means what he says he should invest in one of the many good valve data books available, such as Miniwatt Technical Data or Super Radiotron Valve Manual, both Australian publications. Also recommended are the Mullard publications such as "Valves, Tubes and Semiconductors" and, of course, the classic "RCA Receiving Tube Manual."

Yours faithfully,

J.W.

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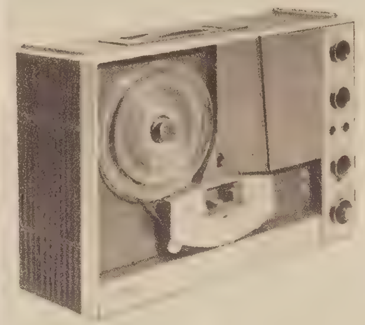

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Well now, having given attention t AM, FM and SSB, we may as we round out the picture by including letter recently to hand from an R.A.N radio operator, based in Victoria. Fro a position of strength, having conquere the Morse Code, he has little patienc for those who are baulked by it.

I will leave it to the "baulkers" t speak for themselves, however. Apar from problems of time and aptitud some of them may, perchance, be les convinced than our correspondent as t the future of "dexterity" modulation.

The other letter in the panel on pag 63 has to do with correspondence an comment in the April issue relating t the amount of data which valve manufacturers make available for their valve The complaint was that valve manufacturers were not nearly as helpful as say, drug houses, who specified dosag with each item supplied to the users.

I took the angle that a great deal o valve data is available but that, of necessity, it has to be interpreted and applie according to the proposed application This was the job of the equipment designer. I asked the question whethe the dosage instructions reflected th same order of accuracy which one expects from a designer of electronic equipment.

Or was it a tribute to the "accommodation" of the human body?

In the letter herewith, J.W. devises his own kind of reply, on the basis that I didn't do an adequate job of taking apart the previous correspondent He concedes, however, that this might have been deliberate.

How right you are J.W.!

While occasionally, I do get rather deeply involved in "Forum" arguments, particularly on pet subjects, more frequently I deliberately leave the subject open for someone else to "have a go." And that applies to all the letters in this issue.

To change the subject completely, there was mention in the June issue of "pirate" broadcasters, who have been plaguing British authorities and who are now threatening to operate off the New Zealand coast.

G.P. of Auckland, N.Z., was inclined to say "good luck to them" if they force the New Zealand broadcasting authorities to provide a wider choice of programs.

A recent news item from England mentions that there are now four pirate broadcasters operating into England and that a fifth is mooted. The British Postmaster-General stated that the activities of radio pirates were creating mounting difficulties with frequency allocation in Europe and said that "the Government was considering how the demand for more popular broadcast music could more rationally be met!"

Did I hear a cheer from G.P. in Auckland?

Did I hear a groan from those who doubt the philosophy that the end justifies the means?

As far as I am concerned, personally, I stand by the sentiments expressed in the February editorial headed "We can do without pirates." In a very real sense, the radio frequency spectrum is public domain and appropriate authorities have as much right — and obligation — to protect it as they have to protect streets, parks and other public property. ■

DISTORTION FACTOR METER

for the home constructor

Many domestic audio installations are constructed at home and some of them have their frequency responses checked with home-constructed audio oscillators. Very few of them have their distortion components measured, however, as the necessary equipment is not usually available. This article is the result of an attempt to fill this requirement with a modern, easily constructed unit.

BY K. C. MATCHETT

For checking the performance of domestic audio equipment in the range 0.1 p.c. to 10 p.c. total harmonic distortion, a simple **distortion-factor** meter is usually adequate, and its correct operation can be ascertained with nothing more than a variable frequency audio oscillator.

The basic features of the distortion-factor meter are shown in block schematic form in figure 1. With the filter section by-passed the signal plus harmonics is measured; the filter is then switched into circuit, removing the fundamental. The residual harmonics are then measured, and the ratio between the two readings is the distortion-factor, which is usually shown:

$$\text{RMS distortion-factor} = \frac{\sqrt{E^2_{f2} + E^2_{f3} + E^2_{f4} \ldots\ldots}}{\sqrt{E^2_{f1} + E^2_{f2} + E^2_{f3} \ldots\ldots}}$$

where

E_{f1}=RMS voltage of fundamental
E_{f2}=RMS voltage of second harmonic
E_{f3}=RMS voltage of third harmonic, etc.

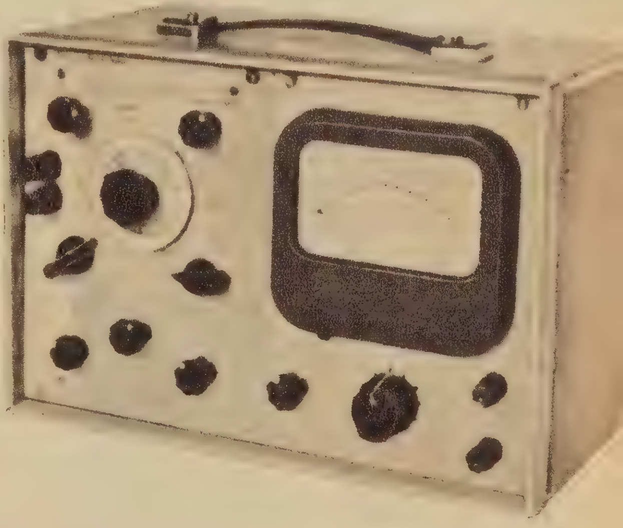
The voltmeter should be of RMS type, such as thermo-electric or moving-iron. The mean-reading rectifier type of meter is much more convenient, but its use will introduce certain errors.

It may be thought that a distortion-factor based on mean values could be used, but this would leave inconsistencies in measurements between closely similar distortion levels, due to the mean value of the waveforms being measured varying with the order of harmonics present, and their relative phase with respect to the fundamental.

The analysis of the response of rectifier instruments to complex waveforms is a very large subject, and outside the scope of this article. If, however, it is assumed that distortion levels above about 10 p.c. are too painful to require accurate distortion-factor measurements, the errors become insignificant.

The RMS value of a signal with 10 p.c. of harmonic added is the square root of 1^2 plus 0.1^2, equals 1.005. The mean value of a signal with 10 p.c. of second harmonic is that of the fundamental alone; if the meter is scaled in RMS values it will read 1.00, an error of 0.5 p.c. The mean value of a signal with 10 p.c. 3rd harmonic will vary over the range: $1 \pm 1/30$, an error of about 3 p.c.

The error in measuring the residual harmonics with the fundamental removed will be greater, due to complex nature of the wave shape, but if a single harmonic is predominant this error will become small as the waveform approaches a sinusoidal shape. The error will be higher when even and odd order harmonics are present to a similar degree, and will depend upon their relative phase. But most authorities put this error at 10 to 15 p.c. maximum, and this is, therefore, the most significant error in setting a limit to the accuracy of this type of instrument.



The author was unfortunately not able to supply an original glossy photograph of the prototype unit, but this re-screened picture gives some idea of its appearance. The portion described in the article occupies the left side of the case; on the right is an AC millivoltmeter

A useful additional facility is the provision of some form of hum rejection circuit, for use when measuring distortion components of an amplitude comparable with the amplitude of mains hum present. A filter providing complete removal of all frequencies below, say, 200 cps, would be ideal, but a simplified form is quite useful, as it can show whether or not hum is masking the distortion measurement, and so indicate if further investigation is necessary.

In the unit to be described the voltmeter section may be any standard audio milli-voltmeter, such as the "Wireless World" unit of June, 1964, or the one described in "Hi-Fi News" in September, 1964. (A transistorised AC millivoltmeter was described in this magazine in January, 1965.—Ed.)

The unit feeding the voltmeter must have two conditions, the first with a flat response and the second with a response that suppresses the fundamental f_1 whilst retaining a flat response outside the stop band, particularly at 2f, 3f, etc., the harmonics to be measured. The overall gain must be the same in the two conditions.

Harmonic distortion introduced on the test signal before the filter must be small, as it is indistinguishable from the distortion to be measured and, therefore, sets the limit to the sensitivity of the instrument.

For many years the standard method of removing the fundamental was by the use of LC filters. These are both bulky and expensive, and unsuited to variable frequency operation, necessitating a separate filter for each test frequency.

Resistance/capacitance filters have now become more common, because of their low cost and ease of operation over a wide range of frequencies. Their major shortcomings is their low effective Q, causing attenuation of the lower order harmonics, as shown in figure 2.

For single-frequency use this can be corrected by the use of an equaliser, but the parameters of such an equaliser are variable with frequency.

It is therefore more usual to correct

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The choice of circuits lies between the rallel-T and the Wien-bridge. The ter (figure 3) has been chosen as be- more suitable for operation over a

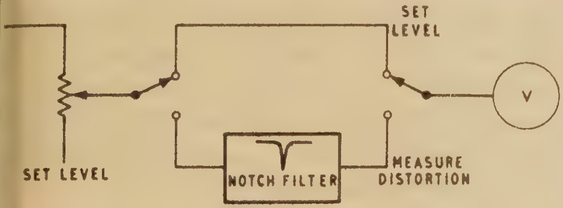

Figure 1: Measurement of distortion involving comparison of the total signal with what remains after fundamental has been rejected by a very sharp filter.

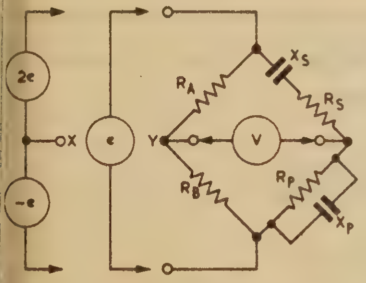

Figure 3a: The basic Wien Bridge circuit, which has advantages over other possible networks.

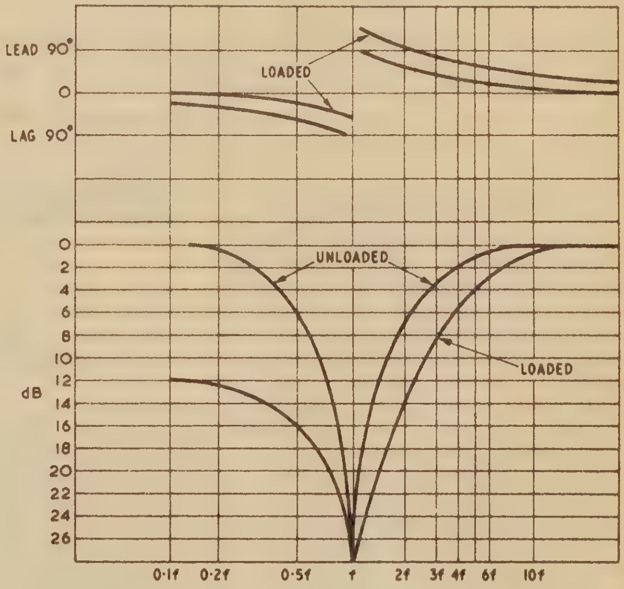

Figure 2 (right): The effect of resistive loading on a Wien Bridge. If the Q is too low, lower order harmonics are attenuated along with the fundamental, lead- to a false reading.

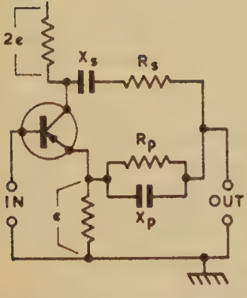

Figure 3b: The Wien Bridge modified for input from a phase-splitting stage.

ide frequency range, as a decade may e covered with two equal value ganged ontrols.

The basic Wien-bridge (figure 3a) is t balance, and there is, therefore, no utput at the frequency at which Xs=Rs nd Xp=Rp then Ra=2Rb.

The one disadvantage of the Wien- ridge is the requirement that only one of the bridge terminals can be earthed. If an earth is connected to one of the input terminals both sides of the output are floating, which may lead to difficulties in the subsequent amplifier stages when measuring signals of the order of a millivolt. A transformer could be used to isolate the input, but good distortion-free transformers with a wide frequency response tend to be expensive. It was, therefore, decided to use a phase-splitter drive.

If the generator is replaced by two antiphase generators in series, of 2e and minus e respectively, it can be seen that at balance, as there is no current in the load, the points X and Y in figure 3a may be shorted, as there is no potential difference between them. This makes the resistive arms Ra and Rb redundant, as they are directly across the generators

The circuit can then be simplified to that of figure 3b the two antiphase generators being replaced by the phase-splitting stage.

Either the resistance or capacitance may be variable for frequency operation, but the maximum practical value of variable capacitor for reasonable size is of the order of 1000pF, which has a reactance of 3.18 megohms at 50 cps, leading to high bridge impedances unsuited for use with transistors unless special circuits are used.

For this reason a variable resistor adjustment was preferred. But normal controls have a limit to their resolution; they are incapable of being adjusted in very small increments, which leads to the provision of both coarse and fine controls for ease in finding an exact null.

An attempt was made to build a circuit to cover a 10:1 frequency range. It worked satisfactorily but was difficult to adjust, especially at the high frequency end of each range. The audio band was, therefore, covered in five bands, each with a frequency range of approximately 4:1.

The curves of figure 2 show the general shape of the frequency and phase response of the basic Wien-bridge, without the application of negative feedback.

The second curves on the same scales show the general effect of resistive loading of the output terminals. As can be seen, this further reduces the response at 2f, 3f, necessitating more correction by the negative feedback loop, while the shift in phase response outside the ±90 deg. sector makes the application of large feedback factors difficult if the circuit is to remain stable.

Phase correction could only be employed if fixed frequency operation was desired. An experimental unit was constructed, in which the bridge was loaded with a common-emitter amplifier, but instability occurred, as expected, when sufficient feedback was applied to correct the frequency response. A common-collector amplifier was therefore used to load the bridge.

The complete circuit of the distortion-factor meter is shown. The input circuit has been kept as simple as possible to prevent the introduction of additional distortion to the signal being measured. The 50K potentiometer (RV1) is used to set the level of the input signal, and provides an input impedance that varies between approximately 10K and 50K; the minimum input signal required for an output of 1V is about 10 mV.

The input impedance is rather low for some purposes, so a two-position attenuator, S2 (one-pole two-way) is provided, which enables a fairly high input impedance of approximately 100K to be obtained, with some sacrifice in sensitivity. The minimum input signal in this condition is of the order of 1V.

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For further details see page 43, March 1966 issue "Electronics Australia".

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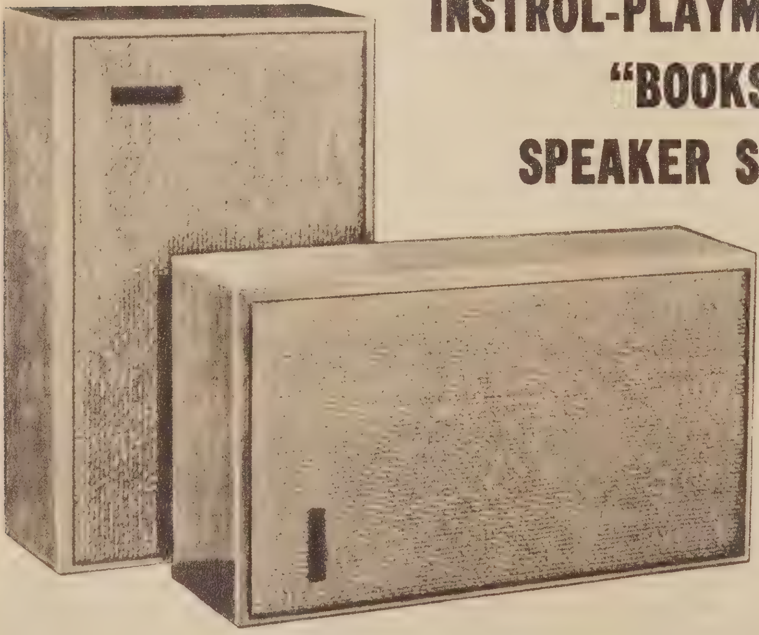

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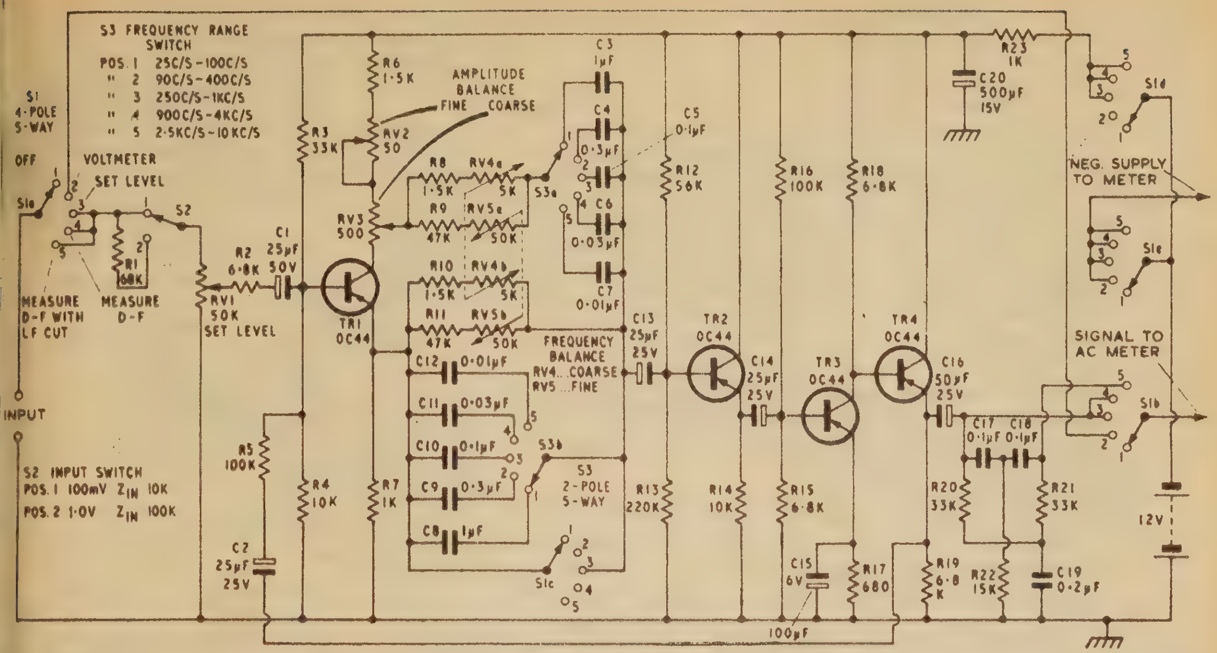
S3 FREQUENCY RANGE SWITCH
POS. 1 25C/S-100C/S
" 2 90C/S-400C/S
" 3 250C/S-1KC/S
" 4 900C/S-4KC/S
" 5 2·5KC/S-10KC/S
S1 4-POLE 5-WAY
OFF
VOLTMETER
SET LEVEL
S1a
S2
R1 68K
MEASURE D-F WITH LF CUT
MEASURE D-F
INPUT
S2 INPUT SWITCH
POS. 1 100mV Z_{IN} 10K
POS. 2 1·0V Z_{IN} 100K
R2 6·8K
C1 25μF 50V
RV1 50K SET LEVEL
R3 33K
R5 100K
C2 25μF 25V
R4 10K
R6 1·5K
RV2 50
RV3 500
TR1 OC44
R7 1K
AMPLITUDE BALANCE
FINE COARSE
R8 1·5K
RV4a 5K
R9 47K
RV5a 50K
R10 1·5K
RV4b 5K
R11 47K
RV5b 50K
S3a
S3b
C3 1μF
C4 0·3μF
C5 0·1μF
C6 0·03μF
C7 0·01μF
C12 0·01μF
C11 0·03μF
C10 0·1μF
C9 0·3μF
C8 1μF
FREQUENCY BALANCE
RV4... COARSE
RV5 ...FINE
S3 2-POLE 5-WAY
S1c
C13 25μF 25V
R12 56K
R13 220K
TR2 OC44
C14 25μF 25V
R14 10K
R16 100K
TR3 OC44
R15 6·8K
C15 6V
100μF
R18 6·8K
R17 680
TR4 OC44
C16 50μF 25V
R19 6·8 K
C20 500μF 15V
R23 1K
C17 0·1μF
C18 0·1μF
R20 33K
R21 33K
R22 15K
C19 0·2μF
S1d
NEG. SUPPLY TO METER
S1e
SIGNAL TO AC METER
S1b
12V

Figure 4: Circuit diagram of the basic distortion factor unit, involving an input amplifier stage, the tunable notch filter and the output amplifier to feed into an external AC millivoltmeter.

trols in its collector. These controls adjust the exact ratio of the two anti-phase signals applied to the bridge, both coarse and fine controls being found desirable for ease of operation. Due to current negative feedback in the emitter, and the low signal level in this stage, the harmonic distortion is of the order of 0.07 pc and sets the lower limit of distortion measurement.

The two output signals from Tr1 feed into the frequency-conscious bridge as described above, the ratio of maximum frequency of the ranges being set by the values of the two 1.5K resistors (R8, R10) and their associated 5K variables (RV4). The actual coverage of each range was chosen to give convenient values of capacitors.

When the instrument is in use it is first necessary to set the output level of the signal, plus distortion. For this adjustment, a flat response is necessary, and is provided by the switch Slc, which short-circuits the parallel bridge arm, giving a gain equal to that at high frequencies when Xp is small compared with Rp.

The bridge is presented with a high load impedance by the emitter-follower Tr2, which in turn drives the common-emitter amplifier Tr3 and its emitter-follower Tr4, which provides a low output impedance to feed the feedback loop, the LF filter and the subsequent voltage measuring circuit, which may be in a detached unit connected by screened cable.

The internal gain of the amplifier is about 180, with approximately 25dB of negative feedback, which produces an overall gain of a little over 10.

The LF cut circuit following Tr4 is switched in and out of circuit by the function control switch S1, and consists of a parallel-T circuit with a null at 50 cps and approximately 10dB cut at 100 cps, the two most common hum frequencies.

The unit was originally constructed in a separate case, but was finally fitted alongside a millivoltmeter in a common case, as this permits input switching from distortion-factor measurement to voltage measurements, and allows the use of common batteries. However, common or separate assembly is a matter of taste, and the use for which the instrument is required.

The photo shows the complete instrument in a case of miniature Imlok with Formica panels. The front panel of the voltmeter was made slightly larger than that of the "Wireless World" design on which it is based, so as to match the front panel of the distortion-factor section. The latter could be reduced in size, but this would lead to a rather crowded control panel.

It was found advisable to fit an aluminium back to the front panel, to prevent hand capacity effects when achieving a final balance.

Figure 5 shows the general layout of the components, but this was not found to be at all critical. All the components except R1, R8, R9 and the panel controls are mounted on the component board, as shown. C20 and some of the bridge capacitors are mounted on the front side of the board, and cannot be seen in the illustration. R1 is fixed to S1, and a small tag-strip is fitted to the front panel to support R8 and R9.

As the test frequency is usually known, the coarse frequency control need not be accurately calibrated. It provides nothing more than a starting point for the balancing operation. If accurate calibration is required with only two scales on the dial, it will be necessary to select the values of the bridge capacitors or pad out their values so that calibrations on different ranges coincide.

The voltmeter range switch is fitted with an additional scale to show the full-scale deflection distortion factor reading: 1V is 100 pc, 300 mV is 30 pc, and so on (See figure 6.)

The instrument so far described can measure total harmonic distortion, but cannot indicate what sort of distortion is present. An additional pair of terminals are provided for connection to an oscilloscope for the inspection of the signal with the fundamental removed. Even a pair of headphones connected across these terminals can give valuable evidence of what sort of signal the meter is measuring.

This oscilloscope output is connected into the circuit of the millivoltmeter so that its gain is utilised, but the signal is not rectified. If the circuit of figure 4 is to be constructed as an independent unit and not housed with a millivoltmeter, the resistor R23 may be omitted and a 9V battery used for the power supply; Sle is then not used.

The completed instrument may be checked for correct performance with the aid of a variable frequency audio oscillator. The overall gain at any fre-

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quency well above the frequency to which the bridge is tuned should be unchanged on switching from SET LEVEL TO MEASURE DISTORTION.

The frequency response in the MEASURE DISTORTION conditions should be checked with constant input volts at twice, three times, etc., the bridge frequency, and the deviation in meter reading should not exceed 0.5dB. This check should be carried out at various frequencies throughout the audio range, and in each case the bridge should be balanced in the normal way at the fundamental frequency before checking the response to the harmonics.

The harmonic distortion introduced by the input stage must be checked, and this measurement requires an oscillator with low distortion. If one is available with a known distortion of less than 0.05 p.c. the instrument is simply checked by measuring the oscillator distortion factor, and comparing the results, taking into consideration that harmonic distortions introduced by successive stages are rarely directly additive.

The enthusiast at home is more likely to have an oscillator with a rather indeterminate distortion in the 0.25 p.c. to 1.0 p.c. range, and this needs to be improved before the internal distortion of the distortion-factor meter can be measured. A simple filter can be constructed to reduce the harmonic content of the oscillator output by a known factor at a single frequency.

If this is chosen somewhere in the centre of the audio band, and the internal distortion of the instrument is satisfactory, at this frequency there is not likely to be much increase in distortion toward the band limits, since the use of a high frequency transistor in the phase-splitter stage gives gain, negative feedback and signal level, all independent of frequency.

A parallel tuned circuit connected across the input terminals with a series resistor to the oscillator output can be made to give an improvement of 10 times or more in oscillator distortion. Any convenient inductor in the mH range can be resonated in the centre of the audio band, with an appropriate value of capacitance. The series resistor should be as high as possible, and still provide sufficient signal for calibration, the higher the value the greater the suppression of harmonics for a given tuned circuit.

A conventional low-pass filter would, of course, give a greater improvement,

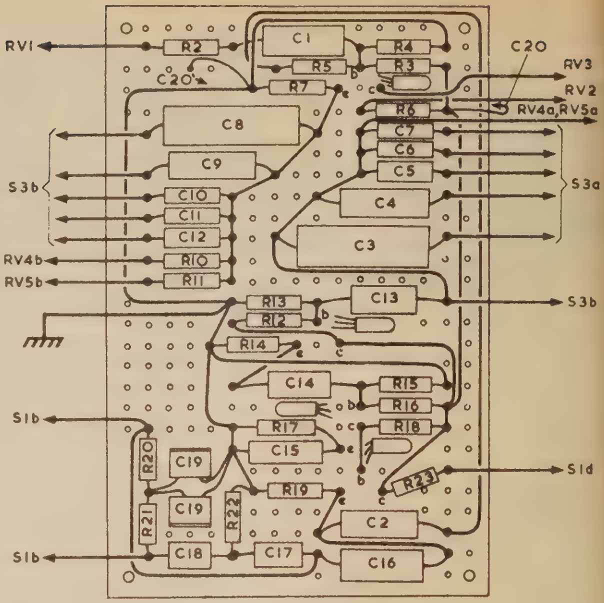

Figure 5: Most of the wiring components in the author's unit were mounted on a single tagboard, as shown. As mentioned in the text, a few components were attached to the other side and do not appear in the drawing.

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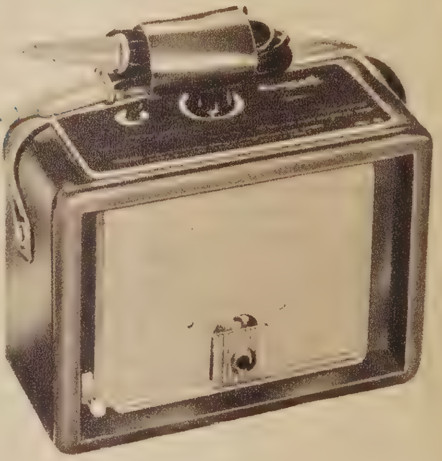

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but for the construction of these the reader is referred to standard works.

The improvement obtained in oscillator waveform can be checked by measuring the relative response at the fundamental frequency and its harmonics, with the filter in circuit. If the response at the second harmonic is one tenth of that at the fundamental, then the harmonic distortion of the oscillator must be improved by a factor of at least 10 times, more if high-order distortions are present.

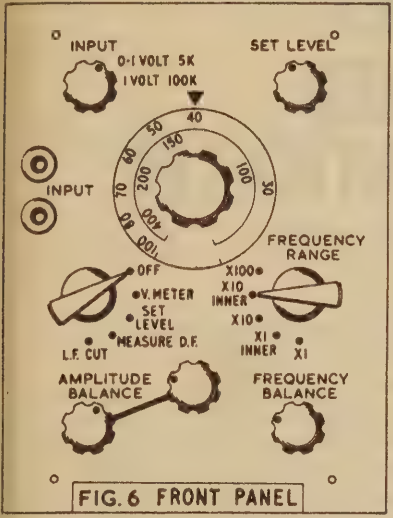

FIG. 6 FRONT PANEL

Figure 6: Suggested layout for the front panel of the distortion measuring unit. This occupies the left hand side of the instrument as pictured on page 65.

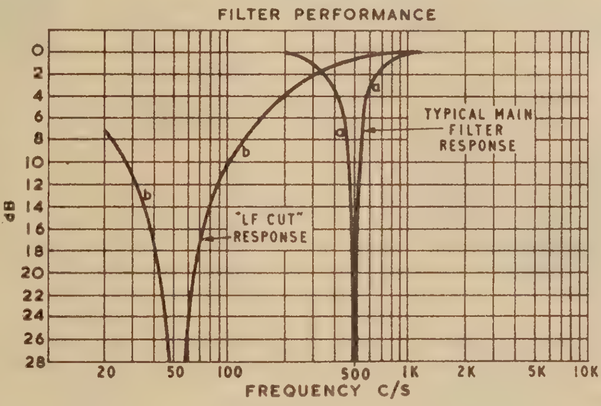

Figure 7: Response of the two filters used in the unit. Note that the response of the main tunable filter is virtually back to reference at frequency 2f.

The measured distortion factor should reflect these improvements in oscillator waveform, and if it does not, this is an indication that excessive distortion is being introduced by the input stage. A final distortion-factor of less than 0.1 p.c. should be achieved.

A typical response curve with the instrument in the MEASURE condition is shown in figure 7 which also includes the LF CUT filter response.

The procedure for measuring distortion is as follows. Set the voltmeter sensitivity switch to 1V, and, with the input attenuator at minimum gain, move function switch S1, to SET LEVEL. Adjust the input controls until the meter reads 1V, representing 100 p.c.

Adjust the frequency range and coarse balance controls to the approximate test frequency, switch to MEASURE DISTORTION and adjust the coarse amplitude and frequency balance controls for a minimum reading on the voltmeter, advancing the voltmeter sensitivity as necessary. As the precise balance point is approached, the controls become too sharp, and adjustments must be made on the fine controls. The final reading on the voltmeter, multiplied by the appropriate range multiplier factor, gives the distortion-factor.

If the function control is now moved to the LF CUT position, and an appreciable fall in the meter reading ensues, it is an indication that some mains hum is present, and a further investigation may be desirable. This last check can only be used if the lowest harmonic present, i.e. the second, lies outside the stop band of the LF cut circuit. This sets the lower limit to the test frequency at about 200 cps.

An oscilloscope inspection of the output signal of the voltmeter amplifier can be used to identify the predominant harmonics, or to show the presence of noise and harmonic signals, such as mains hum. It is an advantage if the oscilloscope timebase is locked to the signal source, or the input signal itself be used to provide the "X" scan. It should be noted that in some cases the waveform may have relatively high-speed transients, usually symmetrical about the base line, which are due to the switching action of the meter rectifiers, and should not be confused with parasitic phenomena.

If there is insufficient signal available to allow a line-up at 1V, then some other convenient level may be employed, with a sacrifice of sensitivity, e.g. a line-up at 0.5V would require the indicated distortion-factor being multiplied by 0.5.

When measuring distortion-factors approaching the internal distortion-factor of the instrument, allowances must be made for an error which becomes greater the lower the distortion to be measured. For instance, in the region 0.1 p.c. to 0.25 p.c. it would be reasonable to deduct half of the internal distortion of the instrument, and expect an error of about the same magnitude as that deducted. Below 0.1 p.c. the instrument can only indicate that the distortion-factor is better than the figure obtained, and nothing more.

(For background reading on this subject, readers are referred to articles in the September and October 1962 issues of "Radio, Television and Hobbies" entitled "A Distortion, Noise and Millivoltmeter" by Jamieson Rowe. Ed.) ◘

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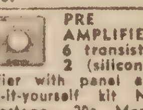

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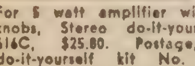

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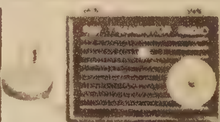

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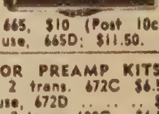

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the "Answer Man" Explains

ZENER DIODES — Their properties

If you have been wondering about Zener diodes this article should be most helpful. Written by J. M. Waddell and D. R. Coleman, it is reproduced from the May 1966 issue of "Components and Equipment Review", issued by Standard Telephones and Cables Pty. Ltd. of Liverpool, Australia.

Among the many new components now appearing in electronic equipment as a result of the intensive work which has been done on semi-conductors in the past few years is a useful group usually known as "Zener" diodes. What are these "Zener" diodes, and what do they do?

If we examine the reverse characteristic of a typical silicon junction rectifier, (figure 1) we can see that the reverse current remains extremely small at all voltage below a certain value, the "Zener voltage." Then, as the voltage is raised slightly above this value, the current increases very rapidly indeed into the so-called "breakdown" region.

For power rectifiers, the manufacturer arranges that this breakdown region occurs well above the normal reverse operating voltage, in order to avoid excessive power dissipation in the reverse direction and consequent failure due to overheating.

It should be noted that this phenomenon is not a breakdown in the ordinary sense of the word (in the sense in which a dielectric breaks down destructively), but is a completely reversible process, which of itself causes no damage to the rectifier.

However, if the rectifier were run continuously in this region it is probable that the maximum allowable dissipation of the device would be exceeded and the rectifier damaged; but if excessive dissipation is avoided the diode can be run in the "broken down" condition indefinitely. A diode used deliberately in this way for any purpose is called a "Zener diode."

The term "Zener diode" was coined when this breakdown was first observed because it was thought that the mechanism responsible was that proposed by C. Zener in 1934 to account for the breakdown of solid dielectrics.

It turns out that this "Zener breakdown" is responsible where the breakdown occurs at low voltages (below 5 volts in silicon), but that at higher voltages breakdown is due to another mechanism, "avalanche multiplication," similar to the breakdown process in gaseous dielectrics described by Townsend. Thus the higher voltage Zener diodes should really be called avalanche diodes. (This term will be explained further at the end of the article.)

While one of the purposes of this article is to draw attention to the different behaviours of Zener and avalanche diodes—for example, the "knee" of the breakdown characteristic is more rounded in a Zener diode and so the slope resistance of such diodes is higher than that of the corresponding avalanche diodes — it is convenient to have a generic term to cover all such devices, and the term "Zener diode" has received widespread acceptance.

It is possible to use a term denoting the application, e.g., "reference diode," "regulator diode," but the range of use of these devices is so vast that no one application can be singled out for such special mention. We recommend the continued use of "Zener diode" as the most useful general term.

One of the great advantages of these devices over previously available voltage stabilising devices, such as gas discharge tubes, is that the breakdown voltage can be controlled during manufacture to any value from about two volts to several hundred volts.

In addition, the transition from "off" to "on" takes place smoothly, without the discontinuity associated with gas discharge tubes.

No special arrangements are needed for starting, and the absence of negative resistance means that shunt

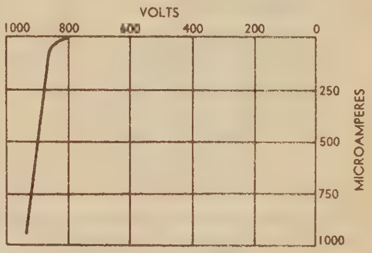

Figure 1: Reverse characteristic of a typical silicon junction rectifier.

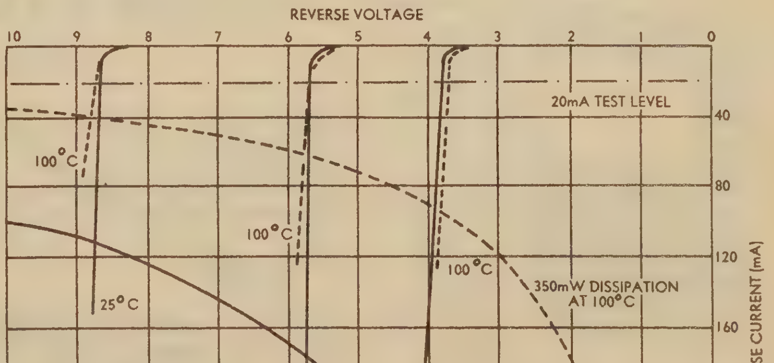

Figure 2: Typical characteristics of diodes specially made for "Zener" operation.

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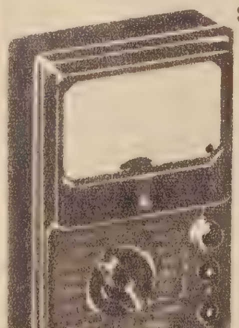

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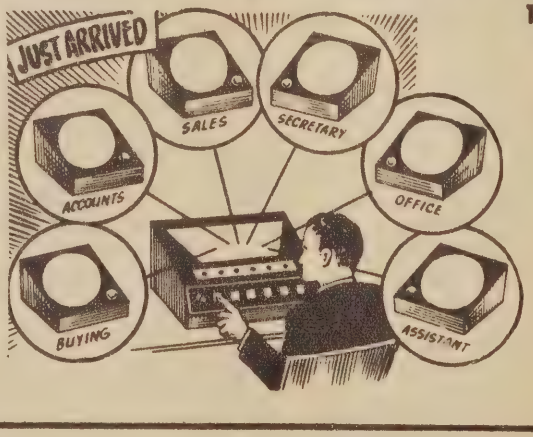

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capacitance can be added without causing oscillation.

Under appropriate conditions, substantially zero temperature coefficients of voltage may be obtained. Furthermore, Zener diodes are smaller and more robust than gas tubes or batteries, and by comparison they have an almost indefinite life.

Figure 2 shows typical characteristics of some diodes specially made for use in this way. It will be noted that here the breakdown voltages are quite low, from about 4 to 9 volts. From this graph the important parameters which define the properties of a particular Zener diode can be clearly seen.

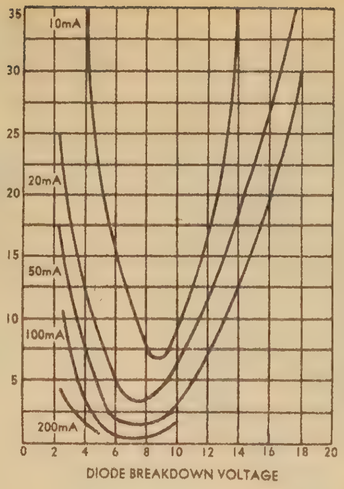

Figure 3: Variation of slope resistance with reverse current for a typical range of Zener diodes.

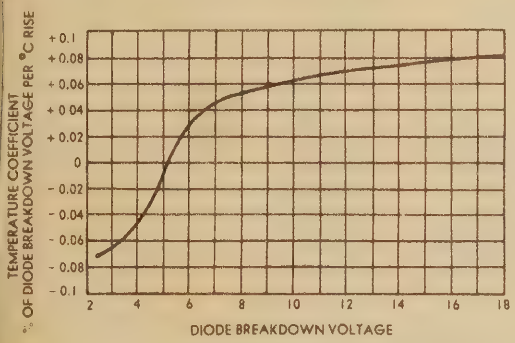

Figure 4: Temperature coefficient of voltage for a typical range of Zener diodes.

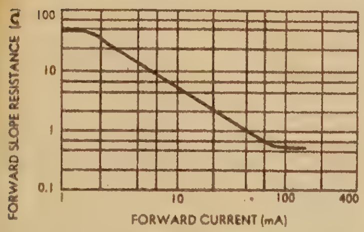

Figure 5: Variation of forward slope resistance for a typical Zener diode.

The first and most important is the voltage in the breakdown region. This is not a unique and fixed value, but increases with the operating current; thus the current at which the voltage is measured must be specified. Usually the manufacturer chooses a particular value of current and quotes the voltages of a complete range of diodes at this particular current.

The next most important parameter is the "slope resistance," or the dynamic resistance of the diode in the "breakdown" region. This again is measured at a particular current, usually the same current as that at which the breakdown voltage is measured. The lower the slope resistance the more constant is the operating voltage with changes in current.

As will be seen from the curves, the operating voltage at a given current changes with working temperature, and so for many applications the temperature coefficient of voltage is also important. Finally, since these devices, like most components, are given a maximum operating temperature, the maximum dissipation limits the maximum continuous working current.

Operating Mechanism. — In order to understand the way in which these various parameters change for different values of working voltages, it is helpful to have some understanding of the alternative mechanisms involved in the breakdown region. In a silicon rectifier biased in the reverse direction almost all the applied voltage appears across the narrow depletion layer located immediately on either side of the junction, and the remaining volume of the silicon is essentially field free.

For a given applied voltage, the field in the depletion layer depends on the width of this layer, being a function of the centre region resistivity of the diode. This resistivity is controlled during manufacture so that the field intensity in the finished diode can be made to have any desired value for a given voltage across the diode; the higher the resistivity, the wider the depletion layer and the lower the field intensity per unit of applied voltage.

The depletion layer is normally quite narrow, so that fields of the order of several hundred thousand volts per cm. are readily reached.

With fields of this order in the depletion layer the current carriers which constitute the reverse current are accelerated to considerable energies between each collision with the stationary silicon atoms of the lattice. As the voltage across the diode is raised, the field increases, and when it reaches a critical value the energy obtained by each electron or hole between collisions is sufficient to eject an additional electron from the atom with which it collides, thus creating a hole-electron pair. These additional free carriers are also accelerated in their turn, and produce yet more free carriers which all add to the total reverse current.

Thus the reverse current, initially no larger than the saturation reverse current present at low voltages, is multiplied to a much larger value by this "avalanche" process, in a manner analogous to the Townsend mechanism in gas discharge tubes.

FOOTNOTES

J. M. Waddell, M.A., A.M.I.E.E., now attached to Texas Instruments Ltd., was formerly with S.T.C. Ltd.

D. R. Coleman B.Sc. (Eng.), A.M.I.E.E. is with S.T.C. Ltd.

The material reproduced represents part 1 of a complete paper entitled "Zener Diodes, The Properties and Applications."

K. B. McAfee, E. J. Ryder, W. Shockley and M. Sparks. "Observations of Zener current in germanium p-n junctions," Phys. Rev., 83, p. 650, 1951.

C. Zener. "Theory of the electrical breakdown of solid dielectrics," Proc. Roy. Soc., 145, p, 523, 1934.

J. S. Townsend. "The passage of ions in gases," Nature, 62, p. 340, 9th August, 1900.

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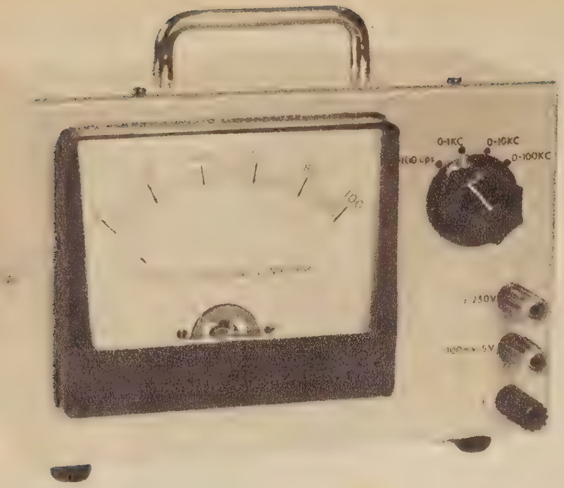


This addition to our range of test instruments is built into our standard instrument case. Additional to suggestions made in the text, it could also be adapted as the indicator for radiation counter devices.

A DIRECT-READING AUDIO FREQUENCY METER

By Ian Pogson

This is the first time we have described a unit which will give direct readings of frequency on the scale of a meter. The audio frequency range is fully covered and extends up to 100KC. Four ranges are provided, 0-100cps, 0-1KC, 0-10KC and 0-100KC. Such an instrument could be used for many applications and we feel that it could be a popular addition to the growing range of test equipment fitted to our small instrument case.

There are often occasions in laboratory work, when it is necessary or desirable to measure the frequency of an alternating voltage which comes into the audio or low supersonic range. Unless a CRO is available with calibrated time base, it may be necessary to resort to some indirect method of comparison or measurement, perhaps combining a CRO and an audio generator. This can be avoided with our new frequency meter, provided the signal to be measured is above 100mV or so

To make a measurement, it is only necessary to feed the signal into the appropriate terminals and to read the frequency off the meter scale, after selecting the most suitable range.

One of our prime design objectives was to have a linear read out from the meter and to this end, we fitted a 0-100 scale. This objective has been achieved substantially, with a centre-scale error of no more than 2 per cent of full scale reading. Where accurate calibrating facilities are available, this error may be corrected as the individual may desire.

Some typical applications for this instrument which come to mind could be the calibration of an audio frequency generator or the adjustment to the required frequency of a fixed audio oscillator. It may also be convenient to place it across the output of an amplifier as a check on frequency when a response curve is being taken. No doubt, quite a number of other applications will suggest themselves to the reader.

One use to which we have put one of these units, is as the frequency measuring device in a set-up for checking the drift of self-excited and crystal oscillators. This method is much easier than setting up a CRO and audio generator to do the same job.

Four transistors are used and, as can be seen from the circuit diagram and photographs, it is a relatively simple device. With all the information given, it should be possible for most interested readers to build it up without difficulty in quite a short time.

The first stage is a straight amplifier with a 470-ohm emitter resistor which is not by-passed, so giving some negative current feedback. This is done to increase the input impedance to this amplifier. As the amplifier will not handle much more than five volts RMS input for satisfactory operation, provision is made for high level input, which will handle up to 250 volts. The 1M resistor used for this purpose, is shunted with 3.3pF to avoid a roll-off in response as the frequency approaches 100KC.

The two following transistors are used in a Schmitt trigger. The purpose of the Schmitt trigger is to square the signal at a constant level, regardless of the input level. The circuit as presented performs this task adequately over the frequency and input level ranges specified.

The output from the Schmitt trigger, at the collector of the third transistor, is then differentiated via the appropriate capacitor and the 15K resistor in the base of the fourth transistor.

This transistor is connected as an emitter follower, biased through the 15K differentiating resistor so that, without a signal, it is not conducting. The meter and potentiometers are connected in its output circuit.

The differentiated signal from the Schmitt trigger is fed to the base of the emitter follower. Here, the negative-going spike is clipped and the positive-going spike appears as a current through the emitter follower circuit. The spikes are integrated mainly by the inertia of the meter movement and the meter gives a reading proportional to the number of spikes which are fed into it. In turn, this is read off in terms of frequency.

The power supply is a simple voltage-doubler from the 6.3 volt winding of the transformer. A transformer with a winding rated at something like 0.5 amp will be more than adequate, as the actual current drain amounts only to milliamps. The rectifiers which we used are a pair of OA91 germanium diodes. The two voltage-doubler capacitors are 500uF electrolytics, rated at a minimum of 9V working. The other 500uF electrolytic should be rated at 12V working.

To protect the OA91 diodes against the initial switching current surge into the electrolytics, an 82ohm resistor is placed in series with the 6.3 volt transformer winding. This resistor also serves as the limiting resistor which is required for the zener diode.

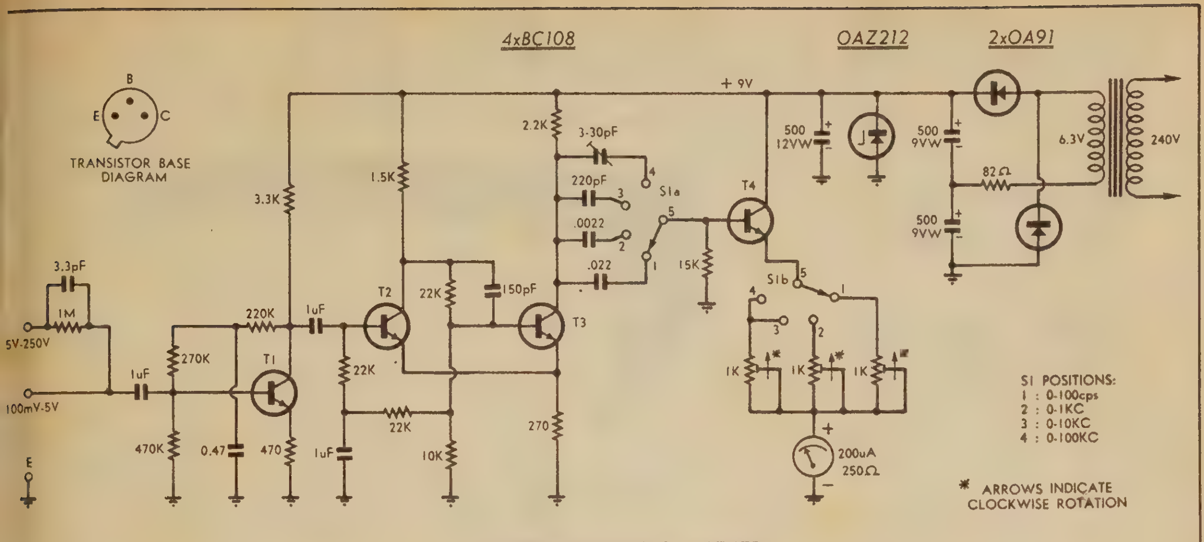
The zener diode which regulates the DC supply voltage is rated nominally at 9.1 volts. The manufacturer's tolerance range is from 7.7 to 10.6 volts. The DC supply voltage will depend in each case upon the actual operating voltage of the zener diode and this can fall anywhere within the range stated above.

The transistors which we have used in this particular model, are the new silicon NPN type BC108. Although the makers list these transistors as being intended primarily for audio use the upper frequency limits extend well into the RF range and they are more than adequate frequency-wise, for our purpose. The gain is high and the price is low, making them an ideal choice.

We have also tried the type BF115 transistor, which is the higher frequency counterpart of the BC108. The BF115 performs quite satisfactorily but the gain is not as high and we have found that the extra gain is desirable, although not essential. The type SE1001 was also tried in another model of the frequency meter and the results were quite satisfactory.

It is very desirable to use a meter of high sensitivity and the one which we used has a full scale deflection of 200 microamps and an internal resistance of 250 ohms. The frontal dimensions are 4¾in x 4in and the large dial, calibrated 0-100 gives an easy-to-read scale. Our meter, model A56, came from Ferrier Electrical Instruments. More than likely, suitable meters will also be available from other manufacturers.

During our development of the instrument, we tried a 0-1 milliamp meter with an internal resistance of 100ohms. By altering the series potentiometer setting for each range, it proved possible to get satisfactory results up to the 0-10Kc range. However, some difficulty



AUDIO FREQUENCY METER

The circuit operation is explained in detail in the text. Where the functions described are new to readers, it should be easily understood when reference is also made to the various wave-forms from the oscilloscope. Although a 200 microamp. meter is specified, less sensitive meters may be used within limits as described in the text.

was experienced in reaching 100KC, but a useful range may be had which falls short of this. Some extension of the range may be had by increasing the capacitance ordinarily provided by the 3-30pF trimmer. This is mentioned more as a guide, since the possibilities of reaching 100Kc under these conditions will depend upon the "spread" of the particular components around this part of the circuit.

So much for the preliminary description of the instrument. For readers who may be interested in going into the functioning of the circuit in a little more detail, we have taken some photographs of the waveforms as seen on one of our laboratory CROs.

The amplifier feeding the Schmitt trigger will only handle an input level of about 100 millivolts before the onset of overload. The first picture shows a sine wave as seen at the collector and before overload. Careful scrutiny of this picture will show two "blips" on each positive - going half - cycle. These are pulses reflected back from the Schmitt trigger and show the points at which the Schmitt trigger is switched on and then off.

The next picture shows the output at the amplifier collector, with an input of five volts. It is obvious that the amplifier is severely overloaded but this does not interfere with the satisfactory operation of the instrument. A close look just below the top flattened part of each cycle will reveal two small blobs, one on either side. Again, these are the result of reflected pulses from the Schmitt trigger and they serve to show that the Schmitt trigger is functioning correctly.

On the bottom portion of each cycle, it will be noted that instead of a flattening of the wave-form, a curve tends to rise in the centre. This turns out to be the limiting factor in the level which can be handled by the system. If the input is further increased, the curve rises up between the two nearly vertical sides of the wave-form. Eventually the top of the curve will reach the level of the top flattened portion.

In addition to normal triggering, this new curve will be seen by the Schmitt trigger as another half-cycle which will also operate the Schmitt trigger. This amounts to the effect of seemingly doubling the frequency of the signal to be measured and so a spurious reading is given. Indeed, as may be expected, the meter will read approximately double the correct frequency.

In order to avoid this problem, the effective input voltage should be limited to about five volts. To enable the amplifier to handle higher input levels, up to 250 volts, a second input terminal has been provided with a simple attenuator consisting of a 1M resistor, shunted with a 3.3pF capacitor.

Whilst we are on the subject of input levels, the minimum input voltage is determined by the amplitude which must be fed to the Schmitt trigger to make it function correctly. Although we have nominated a minimum input of 100mV, the amplifier actually has sufficient gain to operate with an input as low as about 60mV.

Our next point of interest is at the output or collector of the second transistor of the Schmitt trigger. The third picture shows a substantially square wave-form. This is obtained with an input level of 100mV and gives the "mark-space" ratio as shown. The fourth picture shows the change in the "mark-space" ratio when the input level is raised to five volts. This has practically no effect on the meter reading and the reason will become apparent later on.

This square wave must be differentiated and, according to the frequency range to be covered, a suitable time-constant must be provided. This is done by selecting the appropriate capacitor with S1a for the 15K resistor.

Our next picture shows the differentiated wave-form as seen at the base of the emitter follower transistor. The positive-going and negative-going spikes correspond with the leading and trailing edges respectively of the square wave. The relative positions of the positive and negative spikes are determined by the

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1 220K
1 470K
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1 150pF plastic.
1 220pF plastic.
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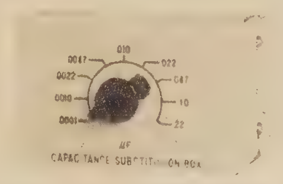

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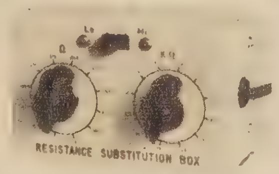

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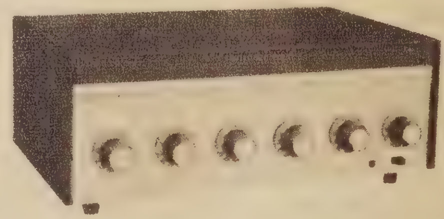

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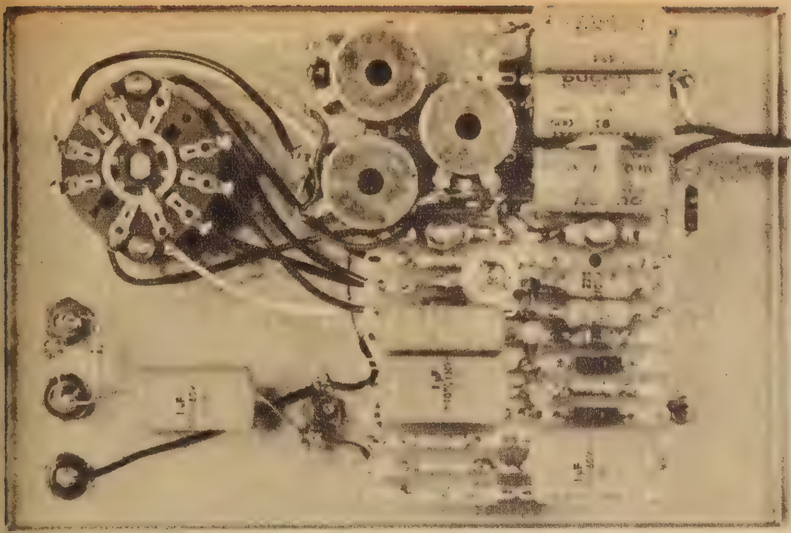


This view looking on the rear of the panel, gives a good idea of the general disposition of the components. For greater detail of the tag board wiring, reference should be made to the wiring diagram. The 1uF input capacitor should be kept clear of the panel.

"mark-space" ratio of the differentiated square wave.

When no signal is being fed into its base, the emitter follower is cut off. When the differentiated signal appears at the base, the transistor will conduct for the duration of the positive-going spikes but will automatically clip the negative-going spikes. The positive spikes at the emitter, are shown in the last picture.

The meter is in series with the emitter of this transistor and the spikes are seen by the meter as a series of short pulses of current flow. Although we have referred to these pulses as "spikes," they do have a finite area. These "areas" are added up or integrated mainly by the mechanical inertia of the meter. The more pulses there are, corresponding to the original frequency, the greater will be the integrated current flow and so the meter reads accordingly.

In order to compensate for variations in the ratios between the different capacitance values in the differentiation network, pre-set potentiometers are switched by S1b in series with the meter. These are set to give the correct full-scale reading for each range.

There is one exception to this. Instead of providing a fourth potentiometer for the 0-100KC range, we have made use of the same one for the 0-100KC range. The full-scale adjustment for the highest range is effected by making the capacitor adjustable. To this end, a Philips 3-30pF trimmer is fitted instead of what would have been a 22pF fixed capacitor.

By this time, some of the more ambitious readers may be considering the possibility of extending the frequency range well beyond the present 100KC. Unfortunately, at least with such a simple approach as this one, there are limitations. With at least two units using substantially the circuit as published, we have been able to extend the range of measurement up to and even a little beyond 200KC. More will be said about this later on.

More than likely, readers who build up this unit will find that they can make theirs read up to 200KC or so. This can be done simply by reducing the value of the 3-30pF trimmer, until the full-scale reading corresponds to 200KC.

A check on the frequency response of the amplifier showed that it was only down a small amount at 500KC. The Schmitt trigger performed satisfactorily up to 200KC, but the square wave showed indications of a gradual fall-off above this frequency. In addition, it was also found that a higher level of input voltage was required to ensure satisfactory triggering as the frequency was extended.

It turn, the deterioration in performance of the Schmitt trigger is reflected in the differentiated pulses. These pulses tend to include a greater area than they should. This tendency for the pulses to change their shape from the desired one cannot be attributed to the Schmitt trigger entirely; stray capacitance in the switching and other components around this part of the circuit are contribbuting factors.

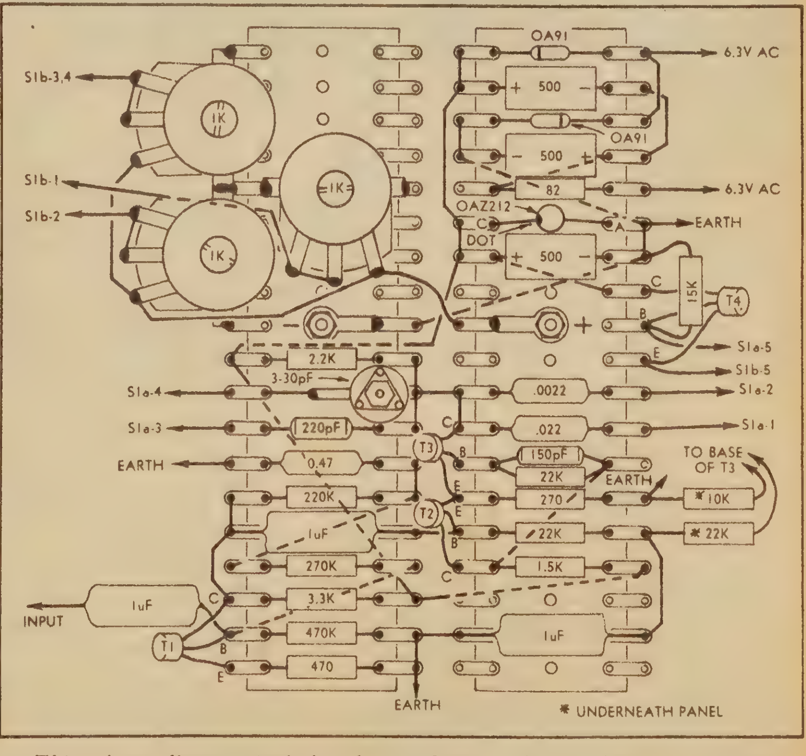
At about the same time as the pulse area starts to increase unduly, there is a tendency for the pulse amplitude to fall, with the interesting result that one effect tends to cancel the other over a limited range. To the purist, this may be cheating but it is an easy way to get a useful extension which would not be available otherwise!

This brief explanation of at least some of the reasons for the limit to the frequency range may pose a challenge to those readers who would like to "have a go" at extending it.

Construction of the unit now claims our attention. In common with quite a number of our recent pieces of test equipment, this frequency meter is built into our standard small instrument case which measures 7½in x 5in x 4in. We built ours the "hard" way by using a case without any pre-punched holes. The front panel was also done by hand, using waxed transfer rub-on type lettering. A coat of clear lacquer was sprayed on to make the job permanent.

In common with most of our projects, manufacturers will more than likely see fit to supply cases ready punched and with a lettered front panel.

It was found convenient to adopt a similar method of construction to what



This wiring diagram includes the tag board only, as there is very little external wiring and this can be seen from the photographs. It should be noted that the three pre-set potentiometers are soldered to tags on the board for anchorage only. Connections are made directly from the potentiometer lugs. Other types may need to be mounted differently.

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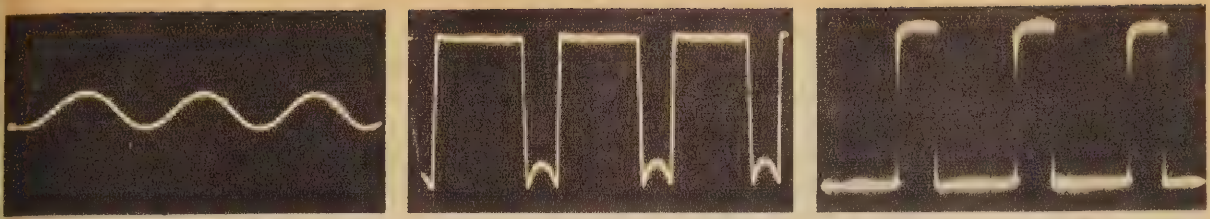
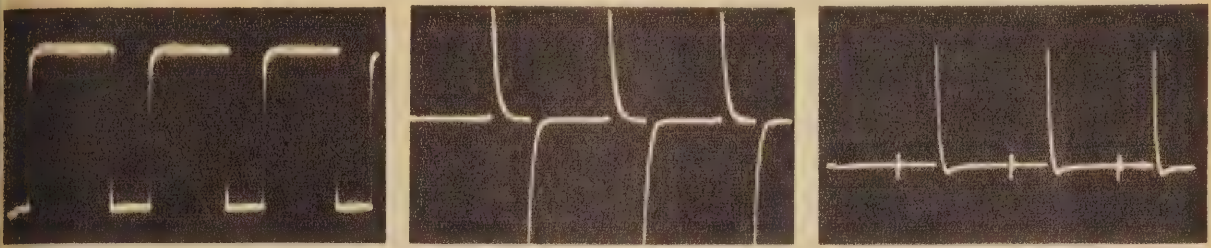


From left to right: First, at collector of the first transistor, before overload. Second, at same collector with the stage overloaded by a 5-volt input signal. Third, at collector of the third transistor, with input to first stage before overload. Note the "mark-space" ratio.



From left to right: Fourth, at collector of the third transistor, with the input stage overloaded as shown in the second wave-form. Note the changed "mark-space" ratio as compared with the third wave-form. Fifth, after differentiation, as seen at the base of the fourth transistor. Sixth, clipped version of previous one, seen at the emitter of the fourth transistor. This one is integrated in the meter circuit.

was used in the 1966 VTVM, in that we mounted most of the components on miniature tag boards. In turn, these are fixed to the back of the meter by means of the two meter terminals.

Components external to these boards are the range switch, three input terminals, a 2-tag strip, a 1M resistor, a 3.3pF and a 1uF capacitor. These are all behind the front panel and may be easily seen in the picture. The power transformer and a 7-tag strip are the only items mounted in the box and these are located on the bottom and towards the back.

To see just how we have wired up the tag boards, reference should be made to the wiring diagram which gives this in complete detail. It is not possible to locate all the components from the pictures, as some of the items are either underneath the board or are hidden by larger components. We suggest that this wiring layout be followed, as it has worked out conveniently in practice. On the other hand, layout does not appear to be all that critical and if it it expedient to make changes to suit the particular purpose, we can see no reason why this should not be done.

The two boards each have 19 pairs of tags. Two of the centre holes, nine from the top are opened up with a drill, so that they will clear the meter terminals. At each of these points a solder lug is used to make the connection from the meter to the required point on the tag strip.

Before wiring the tag strip assembly, it would be a good idea to drill out the mounting holes and screw the strips into place, with a solder lug under each nut. The solder lugs should be looking inwards in each case. Solder the lugs to the adjacent tag which it overlaps. Refer to the wiring diagram and make the connections between adjacent tags as indicated. This will make a stable assembly on which to solder all the components, after it has first been removed from the meter for this purpose.

The usual precautions should be observed when doing this wiring job, such as making sure that there are no dry joints and that components, particularly the transistors, are not overheated in the process. The zener diode should be wired with the lead marked with a red dot to the positive supply line.

Three pre-set potentiometers are fixed mechanically to the tag board by soldering them to suitable tags. These tags are marked on the wiring diagram and provided the same type of potentiometer is used, the same method of fixing can be adopted. It should be pointed out that the wiring connections to the potentiometers are separate from the mounting points. It is quite likely that some readers will use another type of potentiometer and this will make it necessary to find an alternative mounting arrangement. However, this should not present any problem.

It may be noted from the photographs that we have used electrolytic capacitors rated at 16 volts working. This is not necessary for the two voltage doubler units and any rating from 9 volts will be in order. It just happened that we had these capacitors on hand.

It is possible that some confusion could arise when it comes to wiring the switch contacts according to the circuit. It will be noted that there are four positions on each section, beginning with "1" which corresponds to the 0-100cps range. The rotor or common contact is numbered "5" on the circuit. This means that, with the physical arrangement of the lugs on the switch, the numbering will begin with the rotor and will read, 5-1-2-3-4.

There is just one more point before we leave the subject of wiring. The 1uF capacitor between the input terminal and the amplifier base, should be dressed away from the metal panel. This will help to keep stray shunt capacitance to a minimum as far as it affects the higher frequencies.

Having completed the assembly and wiring, before attempting to switch on the power, it is always a good idea to make a thorough check to see that there are no wiring errors. This applies particularly to transistor connections and

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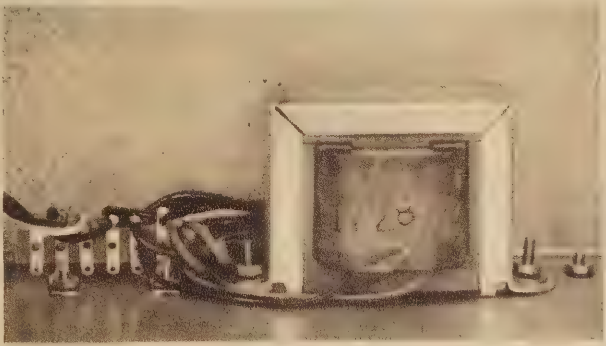
ode polarity. Having done this, it nly remains to calibrate each range nd the unit is ready for service.

Perhaps the easiest way of going about e calibration, would be to use an ccurately calibrated audio generator. resent-day generators usually extend p to at least 100KC and the output oltage level can be adjusted over a ide range. For the moment, we will ssume that a suitable audio generator available.

Set each of the pre-set potentiometers with their rotors to about mid-position. Similarly, the 3-30pF trimmer should be set to about mid-capacitance or a little higher. Set the generator to 100cps and its output voltage to about one volt. The 0-100cps range must also be selected on the frequency meter.



Only the power ransformer and terminating tag trip are mounted in the case. They hould be mounted well back so hat there is no possibility of their ouling any of he components on the wiring board on the front panel.

When power is applied to the frequency meter, the meter should rise to something like full scale or even somewhat higher, according to the setting of the calibrating potentiometer. Adjust this potentiometer so that the meter reads full scale, corresponding to 100cps. Reducing the output frequency from the generator should result in a corresponding reduction in meter reading.

Select in turn, the 0-1KC and 0-10KC ranges and calibrate them in a similar manner by adjusting the appropriate potentiometer. Now select the 0-100KC range and feed in 100KC from the generator. The 3-30pF trimmer is adjusted to give a full-scale reading on the meter.

Varying the input voltage level from say 100mV to 5V should not result in any substantial change in meter reading, although there could be anything up to about a 2 per cent change. The linearity of the readings on the scale may also show anything up to a similar amount of error.

These figures are quite reasonable for such a simple type of instrument and if greater accuracy is required, the errors should be tabulated and may be taken into account when making measurements.

Where readers have built this instrument and do not have access to an audio generator for calibration, the task could be rather difficult. However, here are some suggestions which may be helpful.

For the first three ranges a frequency record could be used with equal effectiveness, when compared with the audio generator. The input to the frequency meter could be fed from connections across the amplifier voice coil. The method of calibration would be similar to that described for the audio generator. In the absence of either facility, here are some further suggestions.

The 0-100cps range is not difficult, in that it is quite easy to use the 50cps from the mains and calibrate at half-scale. A heater winding from a power transformer could be used, but precautions should be taken to avoid overloading the system when using 6.3 volts. As the input impedance of the amplifier is high, the 6.3 volts may be reduced by means of a potentiometer. On the other hand, we have a potentiometer built in and the input may be fed into the high voltage input terminal.

The answer to the calibration problem for the 0-1KC range is not so easy. However, it may be possible to use the tone transmitted by WWV. This is radiated for three minutes out of each five minute period. Two frequencies are used alternately and they are 440cps and 600cps. Provided reception is good then the voice coil connections of the speaker may be fed into the frequency meter and the calibration should be set at either or both of the above frequencies.

If a tuning fork is available, it may be possible to feed it into a microphone and take the output again from the speaker voice coil. The frequency of the tuning fork must of course, be known.

The 0-10KC range can be even more difficult as a reference in this range is not so easy to come by. If nothing else is available, perhaps the best thing would be to calibrate low down on the scale, against a reference at 1KC or the 440cps and 600cps just mentioned. At best, this is a compromise and the accuracy will not be good. However, it may fill in until such time as a better calibration can be made.

We are still left with the 0-100KC range. If a frquency record is available, as referred to earlier, then the highest frequency available may be used. Suppose that this frequency happens to be 15KC. Then the 0-100KC range may be calibrated at the point on the scale corresponding to 15KC and the almost inevitable error will have to be accepted.

If a 100KC crystal oscillator is available, it may be possible to use it. However, two points should be watched. The output level should be determined so that no error will be introduced because of overload or too low a level. In addition, the waveform may be such that an erroneous result may be obtained. This is most likely to show up as an apparent 200KC. The 100KC crystal calibrator which we described recently is suitable for this purpose, the output level being in order and the waveform is also not likely to cause any trouble.

So there it is. Having managed to negotiate all these little hurdles, you should have a useful instrument for measuring frequency within the range up to 100KC. ■

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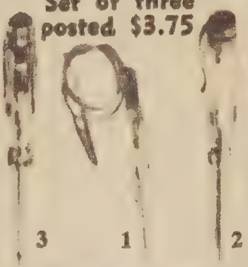

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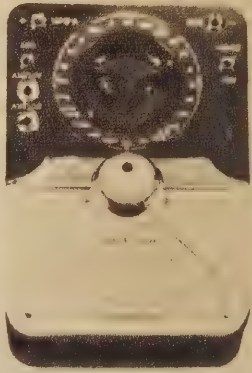

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DC Current: 0-50uA, 0-5-50-500mA.
Resistance: 0-10K, 0-100K, 0-1Meg, 0-10Meg.
(62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).
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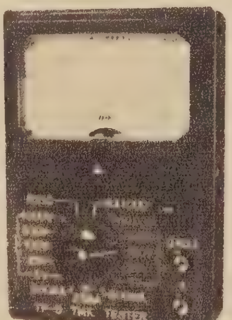

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The Serviceman

ON RECORDERS, BATTERIES, etc.

Some months ago (March 1966) I related the story of a portable tape recorder and the rechargable battery it used. For a number of reasons my investigations could not be carried to their logical conclusion on that occasion, but I now have the opportunity to finish the story. Here it is . . .

My previous story dealt, in particular, with some of the confusion which currently exists about various types of batteries, even among importers and distributors. I hope that this may help to clarify the situation.

On the occasion of my first story I collected quite a deal of information concerning some of the newer batteries, but was unable to put this to practical use — or write about it — before the tape recorder owner was due to leave on a country tour. Thus the whole project had to be shelved for the time being.

Recently, however, the subject came up again. Back from his country tour, my friend intimated that he was still interested in alternative battery types. He wasn't exactly dissatisfied with the replacement battery he had received — in fact, by being kept fully charged, it appeared to be holding its capacity very well — but he still felt some sense of distrust about it.

As he pointed out, he sometimes travelled long distances just to interview one person and it was false economy to risk a recorder failure at such a time.

"In fact," he added, "I feel that I should have two batteries, to be really on the safe side. And, if I can buy a spare which turns out to be a better proposition than the original battery, so much the better."

Thus it was that I raked out the data sheets and notes that I had made about nickel-cadmium cells on the previous occasion, and began once again to assess their possible merit in this application.

The result of all this was a good deal of useful information concerning both the general nature of nickel-cadmium cells and the specific problem of substituting them for the lead-acid type in this particular case. Because the Editor assures me that it will interest many readers, I propose to deal with the general characteristics in some detail first. You'll understand, therefore, if this reads more like a technical article than a "Serviceman" story.

Chemically, there is nothing new about the nickel-cadmium cell. It has been available in at least one form for something like 60 years, and is probably better known as the NIFE cell, made by Alkaline Batteries Ltd., England.

The nickel-cadmium cell uses a positive plate with an active material of nickel hydrate, mixed with pure graphite to improve conduction. The negative plate active material is cadmium oxide and iron oxide. The electrolyte is a solution of potassium hydroxide in water.

(It is sometimes stated that the electrolyte for these batteries is what is commonly called caustic soda, but this is not correct. Caustic soda is sodium hydroxide and, while similar in many respects to potassium hydroxide — particularly in its "caustic" action on skin or flesh — it is quite unsuitable as an electrolyte.)

These cells are characterised by light weight, long life, a high order of reliability, and extreme tolerance to a wide range of operating conditions, many of which would cause premature failure in the lead-acid type. In particular, there is no equivalent of the "sulphated" condition of a lead-acid cell and the nickel-cadmium cell may be left in any state of charge or discharge for long periods without damage.

As might be imagined, they are generally a good deal more expensive than the lead-acid types, particularly in those types, such as car batteries, where large scale production favours the lead-acid type. However, the higher first cost would normally be more than offset by longer life and higher reliability.

As with the conventional lead-acid cells, such as used in cars, the electrolyte is free liquid which is decomposed into hydrogen and oxygen during the charging cycle, and needs to be topped up at regular intervals. Unlike the lead-acid type, however, there is no significant change in the specific gravity of the electrolyte between the charged and discharged condition, and there is no point in taking frequent hydrometer readings.

In this form the nickel-cadmium battery has been extensively used throughout industry for many years. Typical applications range from miner's lamps to electric trucks and locomotives, and include aircraft and marine power plants, railway signalling, and a whole range of emergency applications in hospitals, airports, communications, etc.

In short, it is a well known and well established battery type, ideally suited to many specialised applications.

However, in this form it suffers the same limitations as other "wet" cells, in that its use in portable applications, if not ruled out, is at least restricted.

More recently, there has been developed the completely sealed nickel-cadmium cell which, for all practical purposes, may be treated as "dry" and, in fact, may be used in most applications where the conventional "dry" (zinc-carbon) cell has previously been used.

This development represents quite an achievement. Not only is it necessary to effectively seal the cell so that no electrolyte can escape, but it is also necessary to dispose of the oxygen and hydrogen which are normally generated near the end of the charging cycle, and to avoid any significant loss of electrolyte due to this or other causes, since it is obviously impossible to "top up" such a cell.

The manner in which this has been done is quite ingenious. The cadmium (negative) electrode, which generates hydrogen gas when the cell reaches full charge, is deliberately made with an excess ampere-hour capacity. In this way the electrode is prevented from generating hydrogen, since it never reaches a fully charged condition.

The nickel (positive) electrode generates oxygen after it reaches the full charge condition, but this is directed at the cadmium electrode, with which it combines chemically to form cadmium oxide.

Thus the whole cycle of the cell becomes self contained, and it may be sealed without any problem of gas pressure, provided it is operated within the charging rates set down by the manufacturer. Apart from this, the new cells behave in much the same manner, and have the same admirable characteristics, as their older, "wet," counterparts.

In particular, they do not suffer damage if left on the shelf for long periods, regardless of the state of charge. This is most important where the equipment is subject to intermittent use, with long periods of idleness in between. All that happens is that the cell suffers a slow self-discharge, even to the point where it shows a slight reversal of polarity.

This is a rather frightening experience the first time it is encountered, but the distributors assure me that it is in no way harmful. In fact, they are frequently in this condition when sold, having been in storage for such a long time since their manufacture.

However, one interesting point did arise out of this discussion. Cells which have discharged themselves may need to be "cycled" (i.e., charged and discharged) several times in order to restore them to full capacity, and failure to appreciate this point may lead the user to believe that permanent damage has occured.

In fact, from discussions I have had with several people, I am convinced that this ignorance is the basis for accusations that these cells have no better shelf life than lead-acid types. More publicity on the part of the distributors, concerning this characteristic, might well be indicated.

So much then for the thumbnail sketch of the history and technical details of the nickel-cadmium cell. Having digested most of this myself in the process of determining what was available and the kind of performance that was to be expected, I now had to decide what version, if any, would suit the present problem.

The recorder was so designed that it could be operated from either the lead-acid battery supplied with it, or from five "D" size (950, 1050 etc.) zinc-carbon cells. The latter arrangement was not necessarily an economical one, but very useful in an emergency.

The manner in which these cells were accommodated was quite ingenious. The

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Mullard	2-2
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Playmaster Twin	17
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Philips Magnetic	3V
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Transistor Mono	
Transistor Stereo	

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RECEIVERS

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DXERS (Batt.)	2
DXERS A.C.	2
DXERS A.C.	3
DXERS, 3 Band	3
Interstate	5
Fremodyne	4
Amateur RX	
Transistor	1
Transistor	2
Transistor	3
Transistor	4
Transistor	5
Transistor (R.F.)	7
Transistor	8
Transistor 3 Band	8

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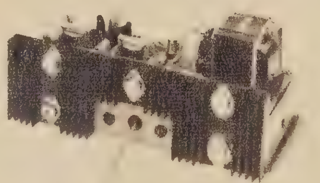
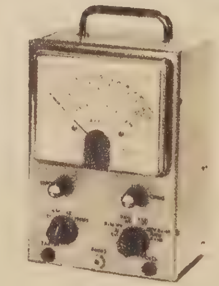
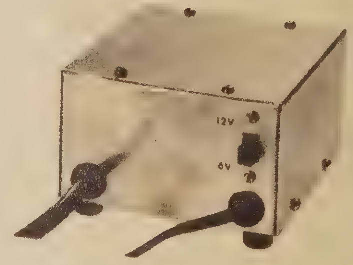


Playmaster 113



1966 VTVM



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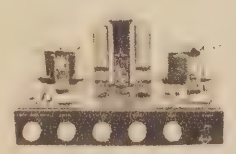

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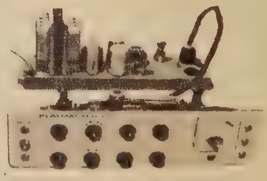

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d-acid battery, although rectangular in ape was the same height and width a "D" cell, and equal in length to ur cells placed side by side. The mpartment in which it was housed as fitted with contacts to suit both it d the "D" cells, while a separate comrtment was provided for the fifth "D" ll.

My original idea had been to deterine whether "D" size cells were availle in the nickel-cadmium range, and mply fit them in the space provided r the zinc-carbon types. This seemed better bet than trying to find someing of the same physical size as the ad-acid battery, which had fairly obously been designed for this instruent.

So, in fact, it proved to be, and this as the first problem solved. However, turned out that there were two types this size, a 2 amp-hour and a 4 np-hour version, so I faced another cision. The original battery, incidentlly, was rated at 2.5 amp-hours.

For a number of reasons I finally deded on the higher rating. For one ing, the lower rating would have the fect of marginally down grading the verall performance, in terms of playg time, while the higher rating would present a significant improvement over e original specifications. In my friend's ase, this could be a useful added feare.

More important, however, was the uestion of battery life. The life of these ells is normally given as the number of harge-discharge cycles it will provide efore its capacity drops to 80pc of the ew cell value. And, because deep cycng is more detrimental than shallow ycling, figures are given for both full ischarge and half discharge cycles.

For the 4 amp-hour cells these were iven as not less than 500 full cycles, nd not less than 1,500 half cycles. herefore, by selecting the heavy duty ersion, I would be encouraging shallow ycling and long life, plus the fact that, ven at the 80pc mark, this version vould still exceed the new capacity of he lead-acid battery.

Incidentally, 1,500 cycles, at one cycle er day, seven days a week, is more han four years, so I reasoned that the ells should last at least this time and night well last twice as long under typial working conditions. Also, the disributors claim that these figures are uite conservative.

So that settled that point.

Next I had to consider how these cells vould fit in with the charger, both as egards the recorder circuitry and the harging requirements of the cells on the ne hand, and the characteristics of the harger, designed for the lead-acid batery, on the other.

I tackled the wiring arrangements irst, with the idea that if the charger roved completely unsuitable, I might ave to provide a separate charger vhich could be plugged in in its stead vhen nickel-cadmium cells were used. Not the most convenient arrangement, erhaps, but one to which my friend vas quite agreeable.

The various connections and possible ombinations associated with the recorder, the lead-acid battery, the charger-cum-power pack, and "D" type cells were quite complex from a design point of view, but relatively simple as far as the user was concerned. In short, the makers had gone to a lot of trouble to make the system as convenient and as near fool-proof as possible.

Briefly, all that was necessary was to insert whichever type of supply one wished to use, the lead-acid battery, "D" cells, or the power pack. The latter was the same physical size as the lead-acid battery and fitted with similar terminals.

Alternatively, the power pack could be located externally and connected via a short cable which plugged into the side of the recorder. With this set-up the power supply would drive the recorder if the lead-acid battery was removed, charge the battery when the latter was in place but when the recorder was not being used, or take over from the battery when the recorder was switched on. In addition, it would switch itself on and off, as a charger, according to the battery's condition.

Whew!

But what, I asked myself, would happen if "D" cells were fitted and the power pack was plugged in and switched on? Would it try to "charge" the "D" cells, or had the makers, reasoning that these would normally be zinc-carbon type, taken precautions to see that this wouldn't happen? I rather hoped that they had overlooked this point, but feared the opposite.

I was right. Although both batteries would, of necessity, have to connect to the same points in the circuit, the recorder seemed to know, in some uncanny way, that it was fitted with "D" cells and not the lead-acid battery, and the charger simply refused to work in these circumstances.

After some study of the circuit (which the owner was fortunate enough to possess) and a detailed study of the recorder, I found out why. A pressure operated contact, located in the lead-acid battery compartment, had to be closed before the charger would function. Normally, the presence of the rectangular lead-acid battery would operate this contact, but it was very cunningly located so that it fell within the space left between two of the circular "D" cells when these were fitted.

I soon fixed that. A small "cheater plate," made from a scrap of light gauge aluminium wrapped with plastic insulation tape, was fitted between the "D" cells and the contact. Thus tricked into thinking that it was fitted with a lead-acid battery, the recorder would now allow the charger to function. To prove this I fitted a set of zinc-carbon cells temporarily, and checked that the charger would "charge" them.

This much achieved, I felt confident in advising the customer that it should be practical to fit a set of "D" size nickel-cadmium cells and charge them in situ, possibly from the charger belonging to the recorder or, at worst, from a separate charger I would have to make up.

So, I placed an order for the cells. Incidentally, the price of a set of five was significantly less than the price originally quoted to replace the defunct lead-acid battery, and this on the basis of the 4 amp-hour types. Had I elected to use the 2 amp-hour types, these would have been slightly cheaper still.

When the cells were duly delivered, and I set about putting them into service, I had a couple of nasty moments. The first was when I put a meter across each as I unpacked it. I didn't expect them to be fully charged, but it came as something of a shock when I found two showing reverse polarity.

In mild panic I rang the technical adviser of the distributors, and asked if this was normal. He laughed good naturedly and explained the point that I made earlier; that these cells are normally left on the shelf with no attention until they are wanted, and that polarity reversal is quite normal and in no way detrimental.

Thus reassured, I connected them in series in a temporary holder (made from a length of cardboard tube and a pair

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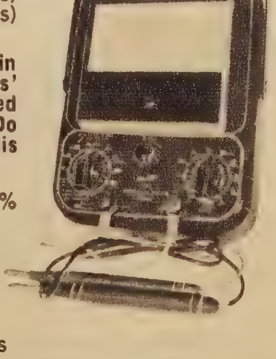

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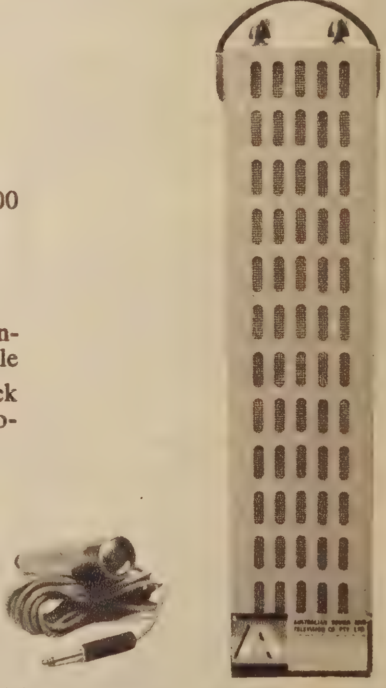

of hastily improvised contacts) and connected them to the workshop charger, adjusting the charging rate to the recommended maximum 10 hour rate, or 400mA in this case.

Having left them on charge for the recommended time (14 hours), plus a bit for luck, I arranged a suitable size resistor to discharge them at an appropriate rate, in order to check their amp-hour capacity.

And this was my second shock, because they delivered less than half the amp-hours I calculated they should. Once again I contacted the technical adviser and stated my problem, and this was when I learned that it might take several cycles to produce the full capacity.

Quite frankly, I was a little dubious, but there was nothing for it but to do as the man said. I needn't have worried. After the second cycle it was obvious that the capacity had improved, and it went on improving over the next four or five cycles. By that time it was so close to normal that I terminated the experiment.

This left one major point still to be clarified; how would the recorder's own charger react with the new batteries in circuit? The main problem here was that it was designed to switch itself on and off. according to the condition of the battery and, since any such device would have to sense the battery's condition very accurately, it seemed too much to expect that it would behave properly with a completely different type of battery.

In fact this proved to be so. There was no difficulty in making the charger work provided the battery was well discharged to start with, but it would not commence the charging cycle for lesser orders of discharge. This contrasted with its behaviour with the lead-acid battery, where it would initiate charging if the battery had been discharged for only a few minutes.

This defect was serious, because it would encourage unnecessarily deep cycling of the battery, and also prevent it from being kept fully charged at all times, ready for any eventuality.

Another problem concerned the "switch-off" function, which refused to operate at all.

Before I could hope to overcome these problems, I had to determine just how the charger sensed the battery's condition. My first reaction was to assume that it measured the battery voltage, but closer inspection of the circircuit, observation of the charger's behaviour, and a hint or two from some colleagues, revealed that it sensed current rather than voltage.

While the battery was charging, the charger's control circuit monitored the current and, when it dropped below a certain point, indicating a fully charged battery, the charger switched off. However, the shut-off was not complete and a small sensing current was allowed to remain, ranging from a few microamps up to about 3mA. At something around this latter value, the charger switched on again.

While it is difficult to be precise about what was, after all, a pretty complex set-up, it appeared that the charger's reluctance to commence charging until the battery was well discharged was due to a marginally higher voltage of the nickel-cadmium battery for a given state of discharge. Similarly, it appeared that the battery voltage did not rise high enough at the end of charge to initiate the switch-off function.

Study of the circuit revealed a 250 ohm variable resistor which controlled the charging rate, and a 15 ohm resistor in the emitter circuit of one of the control transistors which could be varied to adjust the "cut-in" sensitivity. An extra 10 or 12 ohms seemed to make things about right for the nickel-cadmium battery.

Adjusting the "switch-off" sensitivity was not so easy. Some resistor values were changed and a measure of success achieved, but the arrangement was not completely satisfactory. Eventually, it was decided that this requirement could quite safely be ignored.

The basis for this is that the nickel-cadmium cell can be left on charge indefinitely at a rate not exceeding the 50-hour charge rate. The 50 hour rate for 4 amp-hours is 80mA and I found it quite feasible to set the overall charging rate control so that it would drop to this value with a fully charged battery. Under these conditions the charge rate ranged from about 400mA for a well discharged battery to about 200mA for the major portion of the charge, and dropped—slowly—to 80mA at the end.

All of which seemed to be an eminently satisfactory arrangement and very gratifying after all my work. There was, however, one fly in the ointment. Since both batteries were to be available for use at the same time, how should the charger be adjusted. To suit nickel-cadmium or lead-acid?

It was eventually decided to restore it to suit the lead-acid requirements, since this was the battery most likely to be damaged if neglected. Apart from emergencies, this was to be used exclusively as long as it lasted and would then be replaced with the nickel-cadmium, the charger being modified, as indicated, at that time.

In the meantime, the nickel-cadmium battery would be kept charged with a small separate charger. I was able to supply the parts for this, but my friend was sufficiently well versed in simple electrical circuitry to take care of the actual construction himself. At my suggestion he fitted a two position switch which I subsequently adjusted to give either a low (80mA) or high (around 400mA) charging rate. The former would keep the battery pretty well "topped up," and the latter would be needed if the battery was put into service.

My friend also made up a refined version of my battery holder and fitted it and the charger into a single case. By doing all this himself, he was able to save a good deal of my time and a good deal of his money.

This is a long story, and implies a lot of work on one project. This is true to a degree, but some of the time I willingly wrote off to experience, on the grounds that it was an excellent opportunity to gain some practical knowledge about a subject which is likely to become increasingly important in the future.

Also, because my friend was not in a particular hurry, I was able to do a lot of the work in odd moments which might otherwise have been wasted. For this reason, I wasn't quite so heavy handed with his final account as I might otherwise have been. ■

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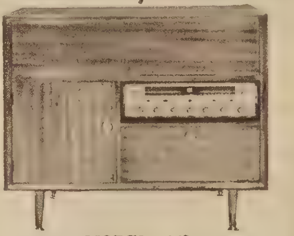

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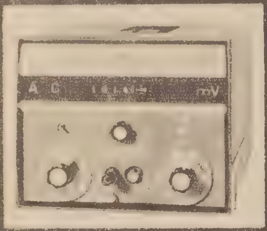

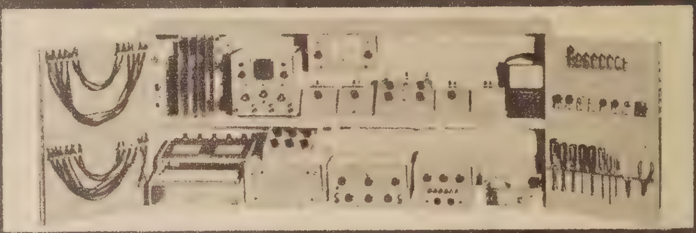

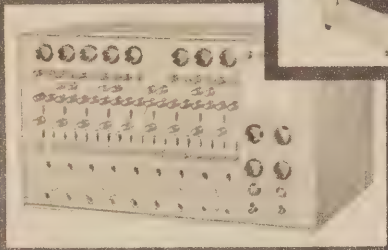

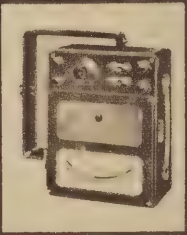

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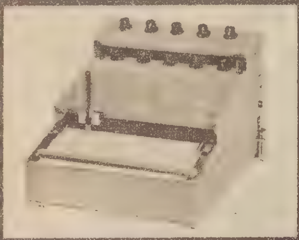

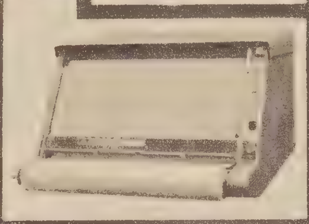

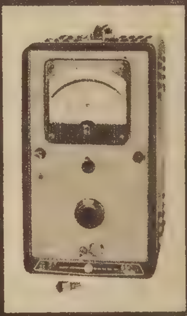

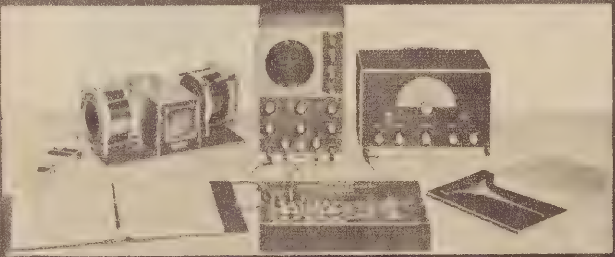

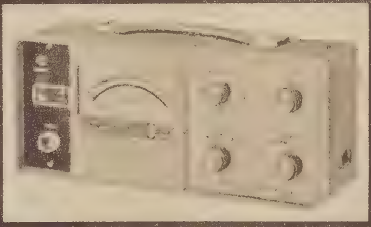

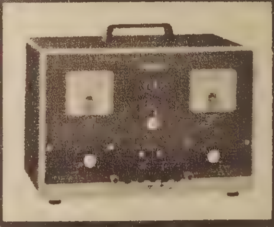

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AUDIO TOPICS

Taped stereo music for next year's cars

If events in Australia follow the pattern which is currently being laid down in America, we may soon be travelling the highway to the sound of tape-recorded stereo music. And, if this happens, the chances are that we will ultimately find ourselves using these same tapes for background music in the home.

By W. N. Williams

Music-while-you-drive is nothing new, of course, as indicated by the fact that a very large proportion of all cars at present on the road are fitted with car radios, covering the medium-wave broadcast band

But while the programs available suit a percentage of the motoring audience, dissatisfaction is expressed on a large scale from those who want background "evergreen" or classical music, without so many commercial interruptions or so much dial twisting.

By and large it is the same audience which has turned away from radio in the home in favour of home record players. Such people want — or think they want — player facilities in their cars so that they can have music they like, anywhere, any time.

How badly they want the facility in what form and for what kind of money is the big question which is currently facing the auto and electronics industry. Quite a few American motorists have already fitted their cars with players of one type or another but what the industry would like to know is whether this comparative trickle will merely continue or turn into a flood.

The factors which will determine it have to do with car-owners, the equipment itself the variety and cost of recordings and the competition offered by AM and, in America, FM radio.

"Automobile" type record players have already flopped. Some years ago, disc players were developed so mounted and so balanced that they were allegedly unaffected by normal movements of a vehicle travelling at speed or over fairly rough roads. Special slow-speed, fine-groove records were issued, some of which are still in the writer's collection.

Perhaps these players were before their time but, in any case, discs would seem to be the wrong medium for a road vehicle, irrespective of their advantages in the home. Even assuming that the playing operation is reduced to pushing the discs into a slot they still have to be manipulated out of or into their jackets — or else left to collect dust and scratches.

Safety demands that the driver must be able to operate a player without diverting his attention from the road. Commercial common sense suggests that he will not punctuate his departure, his journey or his arrival with the chore of sorting out discs.

These latter considerations equally prejudice the idea of using a reel-to-reel tape system in cars. Even though tape itself may have important advantages in this environment, together with a very long potential playing time, threading and rewinding can still amount to an unacceptable chore in the commercial sense.

Tape cassettes appear to be the logical answer to the problem of automobile type players. Cassettes are mechanically self-protecting, substantially impervious to dust, are easy to handle and can have quite long total playing times, with the facility of continuous or "endless" play. In fact, all indications are that the future of car type player systems is bound up with the cassette idea.

Many of the early developmental equipments have followed the obvious approach of supplementing or substituting for the regular car radio, providing a mono program through the normal radio loudspeaker. Pushing a cassette into a suitable slot engages the necessary circuitry and readies the unit to play. The cassettes typically contain ¼-inch endless tapes carrying four tracks, the desired track being selected by a lever which controls the position of the head.

For those who like to "roll their own," mono deck and amplifier kits have been—and are still—available.

Yet another variation simulates stereo by adding a shock-proof reverberation unit, allowing reverberated sound to be fed into the cab via a second loudspeaker.

It would appear likely, however, that the mass market, in America at least, is going to bypass the simpler mono tape player in favour of full stereo. Whether this is based on sales gimmickry, or an extension of the domestic concept, or reflects a technical advantage could well be a subject for debate. But it is not a surprising development in a country which has stereo records, stereo tapes, stereo FM broadcasting and very capacious family cars!

The fact is that current American literature is naming 1967 as the boom year for stereo on the highway. It involves the provision of a stereo tape player in new cars, probably in addition to the AM radio and either two or four loudspeakers to distribute the sound.

"Economy" installations may simply distribute the respective stereo signals to the regular front and rear loudspeakers, ignoring the fact that stereo is fundamentally a left-and-right not a back-and-front presentation.

Better presentation of the sound may be offered by mounting a speaker in each door panel, with the body of the door providing a measure of baffling.

If the doors are too cluttered with mechanism, possible alternatives are the kick panels near the bulkhead, the door pillars or panels adjacent to rear seat—all depending on the design of the car.

Perhaps the most attractive position for the loudspeakers is mounted face-up beneath the sloping front and rear windows, but this involves original provision for the speakers or an expensive conversion.

As a bonus for using four loudspeakers comes the possibility of individual level adjustment, so that front-seat and rear-seat passengers can have a level of sound more to their particular liking.

Reporting in "High Fidelity" magazine, Leonard Marcus has this to say on the subject: "The reason for the excitement is apparent the moment you step into a stereo-equipped car. The effect is like listening to stereo through headphones, only without the discomfort of headphones. Music swirls around the car's interior with vibrant presence and thrilling stereogenics. It may not be

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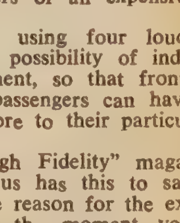

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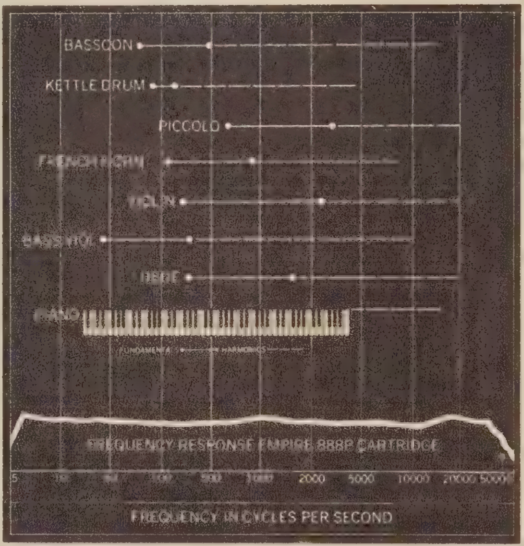

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realistic sound, in terms of the concert hall but, on its own terms—and despite low power and tiny speakers—it's very impressive."

But the really fantastic thing is that the introduction of automobile stereo looks like being bugged by the same old arguments about standards which have followed tape from its very earliest days. Through the years, the tape medium has battled through half a dozen speeds, a variety of reel dimensions, a variety of track configurations, different directions, different ideas about frequency compensation, different attempts at cassette designs and so on ad nauseum.

One would have though that the lesson of non-standardisation would have been learned by this. But no!

Several different systems are currently battling for supremacy, each hoping for a decisive advantage over the others.

- The **Conley** system using the so-called "Fidelipac" cartridge. This employs ¼-inch tape running at 3¾ips and carrying four tracks — or two stereo pairs. Till fairly recently, this was regarded as the "standard" system, involving a dozen or so equipment manufacturers accounting for total sales around the half-million figure. With so many units already on the road and with a well stocked library of cassettes, those conforming to this system feel that they are in a strong position to meet challengers.
- The **Lear** system, using ¼-inch tape, the same 3¾ips speed, continuous loop but 8 tracks instead of 4. From being virtually unknown, the system jumped into prominence when Ford decided to fit its prestige cars with a Motorola player accepting only the Lear cassette. Chrysler and General Motors have now decided to come to the same party, with R.C.A., Columbia, Capitol and Decca backing it with their music repertoire.
- **Orrtronics,** having failed with its earlier 2-track system, has now come out with its own 8-track cassette, for which it claims certain mechanical advantages. It is being backed by Sears Roebuck, by Goodyear, Bendix and various other smaller companies.
- **Norelco** (American outlet for Philips of Holland). This company is preparing to offer a 4-track stereo system on 1/8-inch tape running at 1-7/8ips Developed from other tape equipment produced by the organisation, it is a format which has won acceptance in Europe and Japan and is backed by the powerful 3M company. Available immediately are the music resources of the Philips-owned Mercury label.

As indicated, the tapes in the cassettes are joined, beginning to end, to form an endless loop, which re-circulates for as long as they are allowed to run. The tape peels off the inside of the loop and returns to the outside; throughout the body of the loop, each layer must slide continuously against the surface of the adjacent layers.

Not surprisingly, such a system relies upon using tape with a pre-lubricated surface, both to ensure the necessary slip between layers and to minimise wear. The life of cassetted tape is less than reel-to-reel tape but is nevertheless quite long under proper conditions. Because dust can penetrate the cassette through the open playing slot, it should not face into a airstream within the vehicle, particularly when used under dusty conditions.

Typical cassettes currently available play for 15 or 30 minutes per pair of tracks, after which another pair of tracks can be selected by moving the heads or by electrical switching.

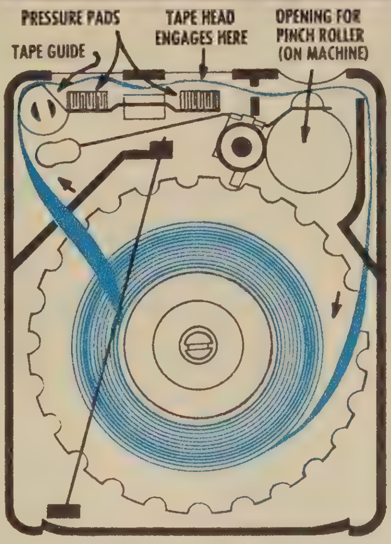
In arranging tapes, a great deal on ingenuity is necessary to ensure that the selections making up each set of tracks exactly fill the loop. With classical music it is virtually impossible to avoid interrupting the work at a point quite unrelated to the music and determined only by playing time.

Another point of difference between loops and standard tapes is that the parallel tracks are recorded in the same direction; the tape is not turned over, the appropriate tracks being selected by moving the head up or down.

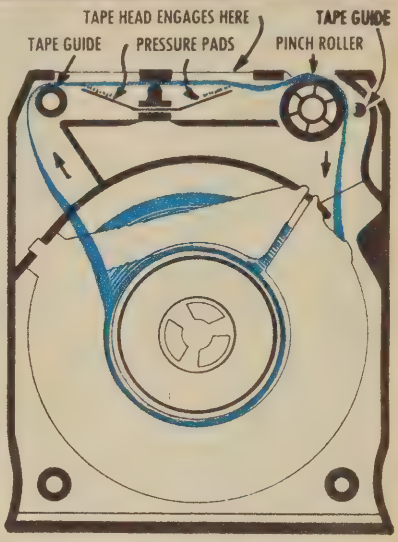
Because of the special requirements of endless loop cassettes, the system does not lend itself at present to home-recorded tapes. Special recorders would be necessary.

On the other hand, there seems to be no special reason why players should not be of the fully "plug-in" type, employed as easily in the home as in the family car. In both cases, permanent loudspeakers would be used, the "plug-in" player simply picking up the appropriate connections and power supply. ◼

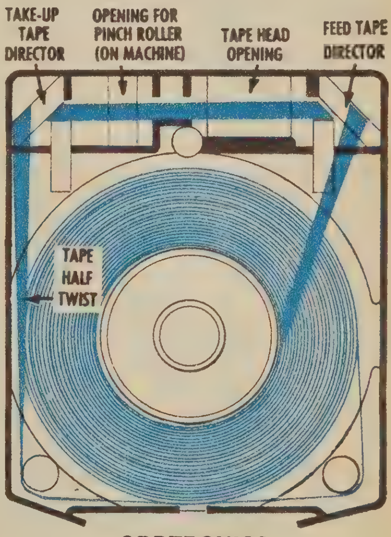
HOW THE CONTINUOUS TAPE LOOP WORKS



FIDELIPAC



LEAR JET



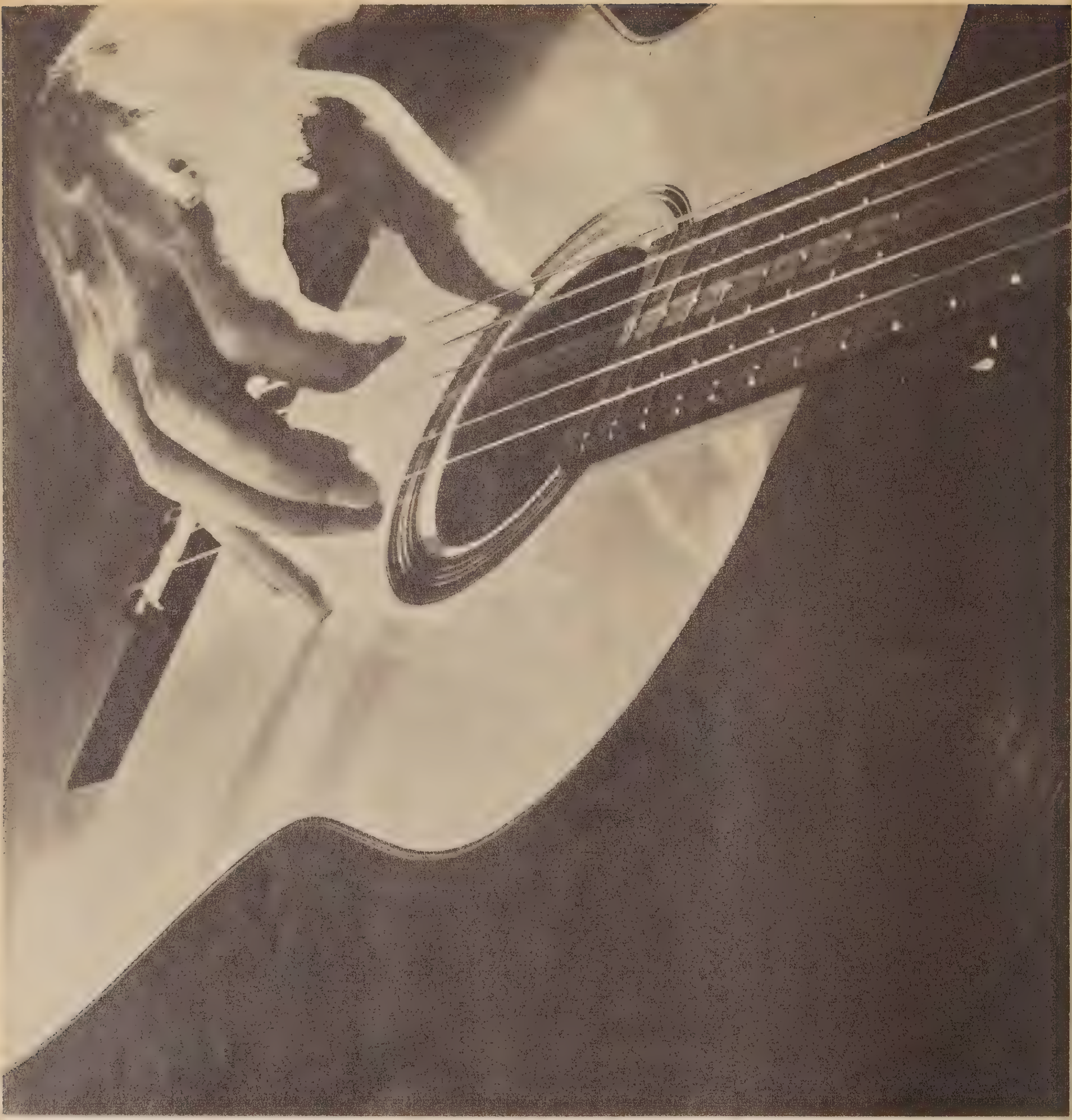
ORRTRONICS

The three continuous loop tape cartridge systems have at least one feature in common: in each the tape peels off from the centre and is returned to the outer lap of the reel. As the drawings show, however, there are significant differences which make each cartridge unique with respect to the others.

In the Fidelipac, the tape passes around a fixed capstan or guide across twin pressure-pads, past the tape head, between the pinch-roller and its drive-roller, and finally returns to the loop. The pinch- and drive-rollers are part of the tape deck, and are introduced to the tape through openings in the cartridge housing.

In the Lear Jet, the tape passes around a guide, across the twin pressure-pads, past the head, around the drive- and pinch-rollers, past another guide, and thence returns to the loop. Here, the roller is part of the cartridge itself and is engaged via an opening in the housing by the drive-roller on the tape deck.

In the Orrtronics, the tape passes over a tape "director" — a guide that causes it to move in a horizontal, rather than a vertical, attitude across the top of the cartridge. The head engages it from beneath. The drive- and pinch-rollers are introduced through openings in the housing. The tape passes another guide and as it comes off it is given a half-twist; it then runs around two more guides at the opposite end of the cartridge before returning to the loop. (From "High Fidelity" Magazine).



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THE "HI-FI" TREATMENT FOR A STANDARD LOUDSPEAKER

From time to time, we hear from readers who, despite the risk of wrecking the cone assembly, modify loudspeakers with a view to securing extended frequency response. This "success" story comes from Mr M. N. McMillan of 138 Broome Street, Cottesloe, W.A. It is produced directly from his letter.

The speaker selected for modification was an Australian-made MSP Jensen AU-69, since this unit was ready to hand and appeared to possess quite good electrical and mechanical characteristics.

It should be noted that not all loudspeakers are suitable for such modification, since many popular types do not have a voice coil and magnet system suitable for longer voice coil travel.

It should also be borne in mind that the fitting of a low resonance suspension system not only reduces the natural bass resonance frequency, but also reduces the power handling capabilities of the speaker. This latter point, however, has not caused any serious worries to the writer at the power levels actually required.

To modify the speaker, the four cardboard strips should first be carefully removed from the outer periphery of the cone. (They can be peeled off with the aid of a small screwdriver.) The strips should be put aside for future use.

Following this operation, the felt dust cover should be completely cut away from the centre of the diaphragm, thus exposing the centre magnetic pole piece. Care must be taken during the operation—and from here on—that no foreign matter gets into the voice coil gap.

Now completely cut away the corrugated surround to the outer periphery of the diaphragm. The writer used a pair of small, but very sharp, scissors for the job.

Centralise the voice coil accurately and carefully with three strips of very thin cardboard or cartridge paper, worked in between the voice coil former and the central magnetic pole piece. Make sure that the diaphragm is at its normal position of rest, being more or less locked in this position by the aforementioned strips.

Prepare a solution of orange flake shellac in methylated spirit — not too thick. When all the flakes have had time to dissolve, filter the solution through a clean handkerchief. Varnish the front of the diaphragm once with this solution and, when dry, give it a second coat. Do not allow any varnish to run into the voice coil gap.

"But wait till I give it the hi-fi treatment!" (The caption is ours. The illustration came from an Amplion advertisement December 23, 1927.)

Allow the cone to become quite dry and hard after this operation—giving it a couple of weeks if necessary.

Now obtain a sheet of 1/8in-thick Estafoam large enough to completely cover the front of the loudspeaker. From this, cut out a ring to exactly replace, dimensionally, the corrugated surround and, of course, of sufficient diameter to extend right to the lip on the outer edge of the speaker "basket."

Using Selley's P.V.A. woodworking glue, fix this ring to the speaker frame, allowing 24 hours to dry. This done, attach the inner section of the foam ring to the diaphragm, using Bostik contact adhesive cement.

From a sheet of thin aluminium, cut a disc slightly larger in diameter than the voice coil former. Hammer this carefully into a hemispherical shape. Remove the three cardboard shims from the voice coil gap and check the movement of the cone to see that it is not rubbing on the pole faces.

Trim the little diaphragm as necessary and attach it, convex side out, to the centre of the main diaphragm with clear nail lacquer. When this has dried hard, lacquer the surface of the aluminium to prevent subsequent corrosion.

At this point, the speaker has been restored to a state where it is quite usable, but further "gilding of the lily" is desirable.

From a Ring-Grip wall-mounting bayonet socket, remove the bakelite section which covers the terminal screw heads and wall mounting screws. It will be found that this section has an internal shape which approximates to an exponential flare. Attach the smaller end of the flared portion rigidly to the diaphragm and over the aluminium disc using P.V.A. woodworking glue. Allow at least 24 hours to dry hard.

Finally, cut from a strip of ¼in Estafoam four pieces each measuring ¾in x ½in. Space these at equal distances apart on the flared end of the bakelite moulding and attach to same with rubber-based contact adhesive cement.

With a "wad-punch" of suitable size, punch out the four holes for the speaker mounting screws. Then attach the four cardboard gasket strips carefully between the holes, using rubber-based adhesive.

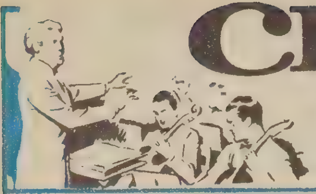
The writer has found that the unit so modified is capable of producing very satisfying sound indeed and, apart from a slight resonance in the upper frequencies, the response is substantially free from unpleasant colouration.

Do not attempt to feed the speaker with more than about 3½ watts of power.

Results could possibly be improved by adding a tweeter and a crossover network operating as far down as 800cps. Under these conditions, the modified Jensen could possibly be mounted in an enclosure of the Mullard horn type, the 12in unit in this case handling only the lower frequencies.

Under these conditions, the bass response should extend downward to approximately 40cps. The system should present sound for which no apology need ever be made.

Needless to say, the modifications suggested are for the guidance of more advanced—and painstaking—experimenters. Novices—or "ham-fisted" experimenters—are advised not to attempt modifications to loudspeakers. It is all too easy to damage the cone system beyond repair and it may not be possible or economical to have a new cone fitted by the manufacturer. ◆



Classical reviews

By JULIAN RUSSELL

New recordings of modern music

MUSIC TODAY. VOL. 1. Recorded under the auspices of the Calouste Gulbenkian Foundation.

Schonberg—Suite for Orchestra.

Lutyens—"O Saisons, O Chateaux." Cantata, Op. 13.

Britten—Prelude and Fugue for 18-part String Orchestra, Op. 29.

Royal Philharmonic Orchestra with Marilyn Tyler (soprano), conducted by Norman del Marr. Record Society Stereo S/6187.

MUSIC TODAY. VOL. 2.

Roberto Gerhard — Dances from "Don Quixote." Symphony No. 1. BBC Symphony Orchestra conducted by Antal Dorati. Record Society Stereo S/6188.

This is the first of what might be a very important and interesting series. Very little contemporary music finds its way in recorded form on to the local market, and even under indent from overseas catalogues the choice is not wide. The Gulbenkian Foundation, at a guess, removes the financial risk attached to the issue of discs whose appeal must necessarily be to a smallish audience but which, in time, might be encouraged to grow.

The difficulty in appreciating contemporary music lies in the fact that, even to skilled musicians, it is generally of such complexity that one performance in a concert hall, even when followed with a previously studied score, leaves the audience uncertain of its value or its capacity to provide enjoyment. Understanding — and appreciation — come only with familiarity, and a gramophone record is certainly the best way of providing a means of repeating the music often enough for the composer's meaning to become clear.

Much contemporary music relies on such technical devices as inversions, retrograde and cancrizans treatment of themes, and a profusion of contrapuntal devices that only a study of the score—or repeated and attentive listening—will clarify the significance. The point is, that however logical the appearance of such devices in a printed score, a theme, when it is played backward or turned upside-down, becomes, so far as the ear is concerned, a new theme.

This, to my mind, is one of the fundamental weaknesses of most serial writing. No matter how ingenious the music may appear in written form, its ultimate effect must depend on how it sounds. A score is only a cipher, a means of communicating to the players the composer's instructions as to what notes he wants played and how he wants them to sound. The music itself does not exist until it is played, for even conductors who specialise in performances of such works are never quite sure, so complex are most contemporary scores, exactly how the music will sound until they themselves hear it at rehearsal.

Neither of these two discs offers much that is insurmountably difficult to any listener who will go to them with an open mind. The accompanying sleeve-notes are explicit enough to make it clear to anyone with an elementary knowledge of the theory of music — old style — or even those without, but with some experience of listening to such contemporary "popular" composers as Bartok, just what the best composers of the new school are aiming at and the methods and principles they use.

But it must be borne in mind that much, but in the records under review not all, of this music is so radically different from any that has been composed before that not even the most educated listener can expect to understand, still less enjoy it, without devoting a little time to making the necessary intellectual adjustments. It may interest and encourage them to know that even the best professional critics try to hear more than one performance of new works in this idiom, and since they are seldom repeated, attend rehearsals to familiarise themselves with the works before they are performed in public.

The founder of this new school was Arnold Schonberg (1874-1951) and it is fitting that the first volume features one of his compositions. However, though this was written when Schonberg was fully mature and in complete control of his new medium, the Suite for String Orchestra is not typical of "serial" music. It is not even "atonal" — a phrase used by him to describe the process by which every note of the scale, including semitones, making 12 in all, has equal importance, and that none can be used as a tonic to which all the others are related.

The suite is firmly based in the key of G Major and though it often wanders far from that key and employs masses of notes not even remotely associated with it, a strong tonal quality remains. By the way, it might be worth bearing in mind that till the end of his life Schonberg continued to write tonal music side by side with his serial works and once told a pupil that "there is still much good music to be written in C Major."

The form of the work is patterned on eighteenth century formulae, and was commissioned for a school orchestra. It might be added in passing that it would need an orchestra of very gifted students indeed to cope with its technical difficulties. The Suite is stimulating both intellectually and emotionally and anyone with a working knowledge of the polyphony of Johann Sebastian Bach should have no difficulty in appreciating the composer's outstanding skill in this type of composition.

The polyphony is much more dense than Bach's and scored in a way that makes it often sound bottom-heavy in the bass, even in its most delicate passages. But it should provide a rewarding study to those desiring to interest themselves in contemporary music. I must admit that to my mind Schonberg, with typical Teutonic pedantry, sometimes goes on talking when he has very little to say, but there are ample compensations to be found in the many passages of outstanding originality and beauty and the playing of the Royal Philharmonic under Norman del Marr is first rate, with engineering to match.

The Lutyens cantata is serial in structure, but the intervals used by the composer, at any rate in the orchestra composed of strings, harp, mandolin and guitar, give the work a strong tonal flavour. The vocal part is another matter. The soprano, Marilyn Taylor, who gets through its delivery with astonishing ease, is called upon to jump from the bottom to the top of her register in apparently unrelated intervals. But somehow everything fits, with eloquent aptness, the imagery of the French poet Rimbaud's exquisite verse which provides Miss Lutyens with her text. It is, all through, a work of the utmost refinement.

The third work, by Benjamin Britten, should present no difficulties to anyone already acquainted with that gifted composer's previous compositions. It was composed in 1943 as a present to Boyd Neel, an old friend and early patron of the composer, to celebrate the tenth birthday of Neel's then famous string orchestra. It is full of ingenuities typical of the composer, and though written in 18 parts, manages to find at least a few bars in which each player can shine on his own. It makes a fitting finale to this very welcome disc.

The choice of music by Gerhard for Volume 2 was a happy one, making available some of the work by a composer little-known even to students of contemporary music. So far as I can trace, this is the first record of his work ever to be issued. He was born in Spain 69 years ago and studied composition there under Pedrell from 1915 to 1922, then went to Vienna for more study under Schonberg from 1923 to 1928. As a sequel to the Spanish Civil War, he has lived in England for the past 25 years.

Although he uses 12-tone techniques, his choice of intervals give his music, too, a strong tonal flavour heightened by the frequent occurrence of vertical harmonic contingencies. After the long reign of nationalistic composers in Spain —and much imitation Spanish music composed by such widely different masters as Tchaikowsky, Rimsky-Korsakoff, Debussy, Chabrier and Ravel —Gerhard's self-avowed aim was to create a school of non-nationalistic Spanish music. His music, however, still retains strong Spanish characteristics, especially rhythmically.

These can easily be detected in the

first number of the "Don Quixote" Suite, a Muleteers' Dance, vigorous in its rhythms yet avoiding such well-known meters as the fandango, bolero and jota. Also to be detected is a strong Stravinskian influence in Gerhard's use of persistent ostinatos. In "The Golden Age" from the same suite, the atmosphere is nocturnal in a Bartokian style, beautiful in texture, almost impressionistic in atmosphere, and with material developed with such simplicity that it is easily enjoyed even at first hearing.

Gerhard uses the chaconne form for "The Cave of Montesino," its treatment again very easy to follow. Among the many technical ingenuities that can be better appreciated after repetition is the inclusion of a secondary theme describing Don Quixote's madness within the knight's main theme and revealed only as the work develops. Gerhard's own notes, which accompany the record, make most of the suite readily accessible to anyone with only a sketchy idea of 12-tone techniques.

The ballet was written in 1931, but the symphony dates from 12 years later. Its form is highly original. Themes are not announced and then developed dialectically. Instead, the music unfolds in a series of "spans" complete in themselves, but closely related to their neighbours on both sides. The result is a quite new perspective in musical form, completely logical and often exciting. The various movements are effectively contrasted in moods and tempos while the whole is fecund in invention.

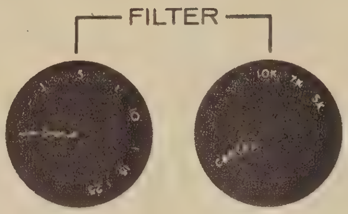
For the playing of the BBC Orchestra under Dorati I can find only the highest praise. It is precise yet sensitive and the clarity of the engineering highlights the continuing accuracy of every department. I would like again to stress the immediate enjoyment that can be had from this music even by newcomers to 12-tone methods. Indeed, only one point puzzled me about the whole enterprise. What is a full-blooded Spaniard doing with a name like Gerhard?

* * *

BYRD AND HIS CONTEMPORARIES. Motets in Paired Settings by Byrd and Palestrina, Philips, Gabrieli, Victoria and Lassus. King's College Choir conducted by David Willcocks. HMV Stereo OASD641.

The "pairing" in this fascinating disc is achieved by recording, side by side, the setting of a Byrd motet with that of the same—or very similar—text by one of his great contemporaries. The results show the great divergence in styles of the various composers both in techniques and emotional content. All the Byrd motets will be familiar to students of Tudor music, and were chosen to present as wide a range as possible of his religious music. The moods vary from the joyous to the mystical, some are dignified, others sweet without cloying, and most are serene.

His contemporaries' settings vary just as widely in mood as Byrd's and though there is never a hint of "competition" in the manner in which they are set out, I am not being insular when I write that mostly I prefer the Byrd versions. But this is a personal preference with which you might easily disagree. The other composers were among



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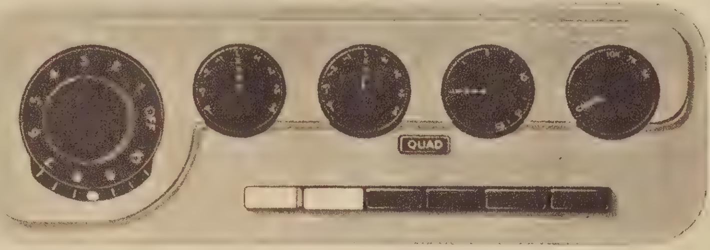

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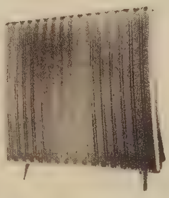

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P4-EL

the greatest of their period and offer much to delight, too.

The whole program is deliciously sung by the choir of King's College, Cambridge, under the direction of David Willcocks. You will hear nothing but impeccable intonation, luminous tone and elegant phrasing. The balance slightly favours the trebles, perhaps because of their preponderance in numbers, but never to the extent of damaging the fabric of the music. Do not be put off from acquiring this record because its music is "ancient." You will find it as enchanting as it is illuminating of compositions from one of music's very greatest periods.

* * *

BEETHOVEN — The Rasoumovsky Quartets, Opus 59 complete. The Harp Quartet, Opus 74. The Juillard String Quartet. Epic Stereo BSC152.

This is the first Juillard "classical" recording to come my way since their notable Mozart performances last year. These latter established the group (till then famous, at any rate in Australia, for their recordings of twentieth-century music) as Mozart players comparable to any others in the world today. The Beethoven performances will further enhance the reputation of this fine quartet.

The Juillard has always been outstanding in the immaculate accuracy of their playing and in their strict interpretations of the composer's markings. A playing of the Rasoumovskys with a score will confirm once again just how closely they obey the composer's directions. Yet they easily surmount any tendency to make them sound too studied and formal. Indeed, it is difficult to recall performances of all three that sound fresher and more spontaneous despite the many hours of rehearsals that must have gone into each, plus the number of subsequent public performances.

Such technical features as ensemble, attack, intonation and phrasing are so perfect that they call for no further comment. And tonally the Juillard's work is so full of surprises that the ear never tires even when tested by listening to all three quartets at a single sitting. This virtue might go a long way toward explaining the group's abiding freshness in their presentation of such well-known works.

All four players share equally the responsibility of the whole. Their style is perfectly uniform in every movement, with engineering that separates every strand of this beautifully woven sound. Since this is an American recording, there is a tendency to sharpness in the treble when played on British designed record-players, but this can easily be adjusted by slightly cutting down the highest frequencies, when the result is entirely satisfactory.

No music lovers will ever agree on the interpretation of every bar in a performance of these three great works, nor, with other performances in mind, will they approve every tempo. All that I can say about this set is that it approaches perfection as closely as I can imagine it and that if different versions appear in the future they will probably remain just different, but certainly not better.

HAYDN—String Quartets in B Minor, E Flat Major (The Joke), and C Major (The Birds). Opus 33, Nos. 1, 2 and 3. The Weller Quartet. Decca Stereo SXL6182.

String Quartets in B Flat Major, G Major (How Do You Do?), and D Major. Opus 33, Nos. 4, 5 and 6. Weller Quartet. Decca Stereo SXL6183.

Here is quartet playing very different in approach to that of the Juillard, but in its own way just as excellent. The Weller is a young quartet made up of members of the Vienna Philharmonic Orchestra, whose string section is still probably the finest in the whole world. And here again, as in the quartets reviewed above, you will hear the same unanimity of purpose and the same fusing of four minds into one directing intelligence. And again an atmosphere of imperishable freshness pervades every one of the six quartets that make up these two discs, which, by the way, can be bought separately.

Moreover, these players successfully avoid one of the pitfalls that await so many exponents of Haydn's music—a continuing uniformity of style that robs the works of their individuality. Each of the six quartets, as presented by the Weller, remain quite remarkably different while still obeying all the rules of period style, which is always impeccably observed.

I can use nothing but praise for the technical perfection of all four players and for the fidelity of Decca's engineering. Haydn is still under-represented in the world's record catalogues and these two new discs should fill one of the gaps with very great distinction. I look forward eagerly to any new performances recorded by the Weller, and to the possibility of their making an Australian tour under the direction of Musica Viva.

* * *

TCHAIKOWSKY — Piano Concertos No. 2 in G Major, and No. 3 in E Flat Major. Gary Graffman and the Philadelphia Orchestra conducted by Eugene Ormandy. CBS Stereo 235139.

Here is a performance delivered with all the panache of Tchaikowsky-playing at its best and most luscious. Both soloist and orchestra delight in the rich melodies that came from the pen of one of the world's greatest melodists. And both can communicate this delight to listeners to whom the concerto has, over the years, become only too familiar. The interest they generate all through carries one without effort over the undistinguished development section of the first movement.

Technically, the playing of Graffmann and every last man in the Philadelphia is beyond criticism. And this superb equipment is used without ever imparting any sense of strain or of virtuosity for virtuosity's sake. The slow movement is as beautifully played as I've ever heard it and the Finale is quiet wonderfully exhilarating in its rhythmic exhuberance. I could find only one small passage in which the engineering wasn't always absolutely faithful and in perfect balance. This is in the second movement, where the cello part, in duet with a solo violin, receives just a trifle too much prominence—a pretty good tally in a work such as this.

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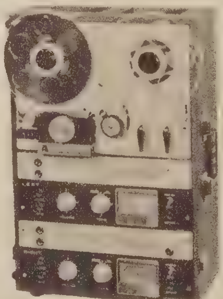

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The Third Piano Concerto is in a single movement and is based on themes in no way comparable in interest or beauty to those found in the Second. But they are all worked out to provide soloist and orchestra with plenty of material to dazzle the ear even if it never quite succeeds in convincing the mind of its worth. However, it makes an admirable fill and will appeal to many merely on the grounds of its unfamiliarity.

★ ★ ★

BACH. Volume 3, The Well-Tempered Clavier, Book 1, Preludes and Fugues Nos. 17-24. Glenn Gould (piano). CBS Stereo SBR 235146.

This young Canadian's eccentricities are now well-known to many record buyers. They take the form of unpredictable whims in the matter of interpretation and the intrusion of noisy vocal contributions, including tuneless singing, during his often brilliant playing. Mercifully, these latter irritating incursions are less frequent on this disc than on some of his earlier ones, though in the B Flat Minor his emotional vocal accompaniment becomes more distracting every time I hear it.

His approach to Bach is, to say the least, more than a little odd. Though he keeps his notes very carefully detached from each other, even in legato passages, in the harpsichord style, he makes no effort to imitate the timbre of that instrument as so many other Bach pianists do nowadays. His handling of ornaments is what I can only describe as capricious. Sometimes he omits trills, at others he shortens them for no very good reason that I can determine. Sometimes he uses double-dotting, sometimes he doesn't. He hardly ever uses the sustaining pedal at all, however cantabile the melody he shapes with such care.

Yet despite all the distracting idiosyncrasies these are brilliant performances for the simple reason that he is a very fine pianist indeed, with a deeply perceptive musical intelligence. For that reason I should not like anything I have written to dissuade anyone from acquiring this most interesting and, for the most part, enjoyable disc. His interpretations may well be very different from any to which you are accustomed, but he makes out a valid case for most of his departures from tradition and his whole performance is exhilaratingly young and intense.

★ ★ ★

MENDELSSOHN — Violin Concerto in E Minor, Op. 64.

BRUCH — Violin Concerto in G Minor, Op. 26.

Ion Voicou with the London Symphony Orchestra conducted by Rafael Fruhbeck de Burgos. Decca Stereo SXLA6184.

Here is a 40-year-old Rumanian violinist unknown to me till this record turned up, with an impressive technique, but a rather limited tonal range, something that is a pretty serious drawback in a juicy work like the Bruch, and also a handicap in the Mendelssohn. Although he offers many passages of virtuoso brilliance, the net result of his effort is disappointing when compared to the many alternative couplings, some of them of great distinction, with which they must compete. ■

DOCUMENTARY RECORDS

Reviewed by Ellis Blain

BRENDAN BEHAN SINGS IRISH SONGS AND BALLADS. Spoken Arts 760.

Behan is a bit dated now and it is too soon for history's estimate of him. But as a character, a personality, he has his place even in the in-between. The apparent bawdiness of much of his work doubtless was responsible for a certain over notoriousness at the height of his popularity but, to make any realistic estimate of him, we must look a little deeper . . .

He was a ruffian, of course, but he was a poet too. His father first saw him from his cell window and Brendan is an alumnus of Borstal. Perhaps even more spectacular was his achievement in getting himself arrested at his own play in the West End.

But he was a sensitive man; so much so that, rather than compromise with his principles by standing up for the National Anthem or hurt the feelings of an English friend, he managed to disappear at the crucial moment. He had a great respect for skill in any form and often refused to recognise right or wrong when a principle was at stake.

He displayed extraordinary courage yet regarded himself as a coward — but there was no weeping over himself, no trace of self-pity to be found in the man or his writing . . .

Among the trifles here recorded are popular songs and Brendan's own Irish translations of Napoleonic hymns. All are seasoned with his own inimitable spontaneous comments, uniquely unorthodox and often uproariously funny. Strong meat perhaps, and plenty of drink with it but, at the same time, an invaluable reminder of a beloved eccentric.

★ ★ ★

THE SERIOUSNESS OF HUMOUR. Malcom Muggeridge. Parlophone PMC 1211.

"I am by nature a very serious person but quite early on in life I made a curious discovery. Whenever I was serious, people thought I was being funny and whenever I tried to be funny, everyone assumed I was in deadly earnest . . ."

These self-revelations by Muggeridge do more than any dissertation I could conceive to explain the extraordinary attraction this anachronistic Englishman continues to hold for English speaking peoples outside the British Isles.

Not so long ago, you may remember he shocked these same English speaking peoples by attacking royalty in the American press. He will never be forgiven in his native land but, already he has returned to favour almost everywhere else. This re-instatement is not due to any change of attitude on his part but to a growing realisation that much of what he said was a good deal more serious and appropriate than was recognised at the time.

But to return to this record. It is interesting that it is an imported English Parlophone pressing of a recording made originally before an Australian audience at the Assembly Hall in Sydney. Muggeridge is enjoying himself hugely, showing off at everybody's expense, including his own which, one assumes is the only course remaining to a lecturer who claims "I have always suffered from the disability of having nothing to say; no proposals for promoting human felicity; no panacea for human ills; no 'message' of any kind to proclaim."

Quotes from the BBC

"I believe that laughter is an important thing and that serious people tend to be superficial. They are superficial and a little ridiculous because they get fixed ideas and mental habits, whereas, from time to time, one should burst out laughing, and so burst the crust, the screen which gets between oneself and the virgin vision of things and the world." (Playwright Eugene Ionesco.)

"Poetry can help us to celebrate the happiest passions. It can help us to express, and to face, the blackest moment of life. After ecstasy, after pain, the poet always comes up singing. And if his song is true to our own experience, it becomes our song as well. (Adrian Mitchell, British poet and critic.)

THE ART OF RUTH DRAPER. Spoken Arts 779.

Ruth Draper was known the world over as the greatest monologuist of all time. For fifty years she toured and was recognised as a fellow artist by the great actresses of her time, Duse, Bernhardt and Ellen Terry, and paeans of critical praise were heaped upon her. She died in her sleep on December 30, 1956, and there is no doubt that the world lost a great and a unique artist.

Ruth Draper's supreme status in her field may have been due to her recognition of her own work as true drama. It succeeded in its own right, as such, rather than on account of its novelty value. She demands only your interest in her characters per se, not your astonishment at her creation of them. As Brooks Atkinson, Drama Critic of the "New York Times," put it, "She knows that human beings are silly, selfish, ignorant, incompetent and unhappy. But she does not condemn them for their frailties."

If you perceive traces of nobility lurking inside the most unlikely of them, you need not wonder where it comes from. It comes from her. She puts it there. She has a compassionate knowledge of human character out of which she recreates the things she admires."

This invaluable recording was made in 1954 while Ruth Draper was appearing at the Vanderbilt Theatre in New York for her "farewell engagement." It contains some of her best known dramas, "The Italian Lesson," "Three Generations In A Court Of Domestic Relations" and "The Scottish Immigrant." The recording wears well as does the art of the woman it recreates. ■

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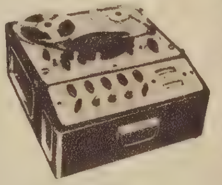

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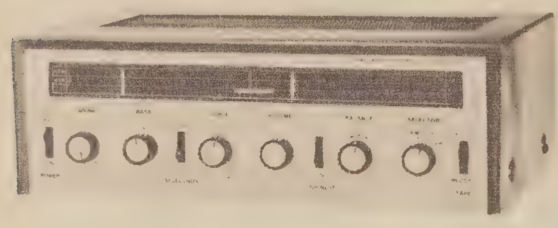

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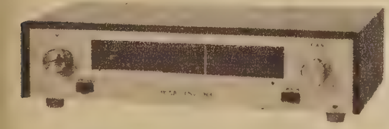

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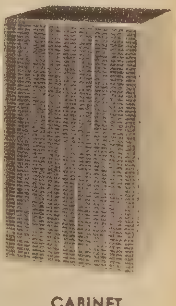

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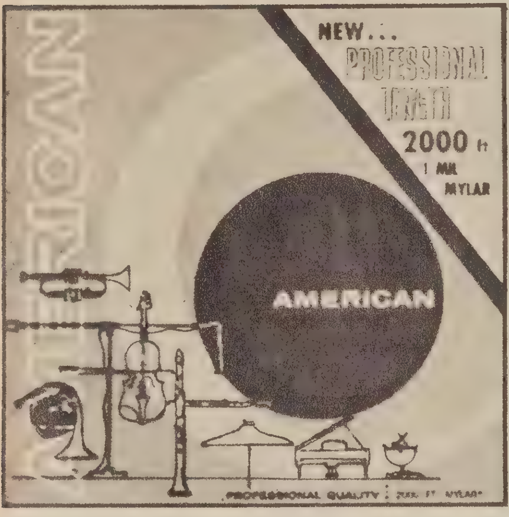

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"ELECTRONICS Australia"
Staff Review
Panel

Devotional

HIS LOVE IS IN MY HEART. Helene Landrum, Soprano. With the Paul Mickelson Orchestra and Choir. Stereo, Supreme SS-2012. Also available in mono SM-1012. (Supreme Productions Ltd., Box 15, Footscray, Vic.)

Interest: Outstanding soprano.
Performance: Yes, outstanding.
Quality: Good.
Stereo: Modest.

When I first heard Helene Landrum, some months ago, I was tremendously impressed by her voice, her musicianship and her sincerity as a Gospel singer. This latest record fully confirms that early judgment.

Beginning from High School days, when she sang for choral and other productions, Helene Landrum has gradually widened her experience to take in sacred opera and oratorio, solo work in churches, appearances on radio and television, and with the Burbank and Huntington Park symphony orchestras.

Backed here by the Paul Mickelson Orchestra and Choir, she presents a program ranging from the classical and traditional to a popular — though dignified — "If You Know The Lord."

The Titles: His Love Is In My Heart —Star Of Hope — He's Only A Prayer Away — There Is A Way Of Prayer — Hosanna — Largo from Xerxes — Come Thou Fount — If You Know The Lord — I Heard The Voice Of Jesus Say — Hallelujah.

With a voice that is strong and pure and ranging far up the scale, the performance reflects the singer's background of opera and oratorio, but without any suggestion of the forbidding or artificial. A record you should hear. (W.N.W.)

★ ★ ★

HYMNS OF CHILDHOOD. The Ivan Rixon Chorale. Organist Werner Baer. Stereo, World Record Club. ST4073. Also available in mono.

Interest: Favourite children's hymns.
Performance: Virtually flawless.
Quality: Excellent.
Stereo: Natural spread.

This is the third album of hymns I have reviewed recently for the World Record Club, recorded in Sydney by the Ivan Rixon Chorale. I wouldn't be surprised if it also turns out to be the most popular.

As the title suggests, it is an album of children's hymns, to which children with any background of Sunday School at all will most certainly respond. But the hymns are so timeless and sung so well that they must have a potential appeal to any age group.

Under the baton of Ivan Rixon, a very experienced musician and conductor, the chorale attempts no special arrangement or embellishment of the hymns, laying the emphasis purely on melody and expression, with the supporting parts deliberately restrained.

Werner Baer, from the staff of the Australian Broadcasting Commission, and another well-known musician, warrants special mention for his support on the Conn electronic organ. Were it not for the acknowledgment on the cover I would have been hard put to it to distinguish the sound from that of a pipe organ.

The hymn titles are: Jesus Bids Us Shine — What A Friend We Have In Jesus—All Things Bright And Beautiful—Jesus Loves Me, This I Know—Away In A Manger—O, What Can Little Hands Do — Jesus, Friend Of Little Children — Come, Children, Join To Sing—I Love To Hear The Story—Children Of Jerusalem—Once In Royal David's City—Tell Me The Old, Old Story.

Ivan Rixon

An excellent album—simple in concept but so well done. (W.N.W.)

★ ★ ★

ALL IN THE APRIL EVENING. Eddie Calvert, Trumpet, with Ivor Raymonde and his Orchestra. Mono, Columbia 330SX-1776. Also available in stereo.

Interest: Gospel trumpeter.
Performance: Enjoyable.
Quality: Excellent.

Having not previously heard Eddie Calvert, I had no idea what to expect of this album. While I have every regard for the trumpet as a lead instrument, I was not so sure about the effect of twelve successive Gospel songs, all featuring solo trumpet.

I needn't have worried. The orchestra and chorus under Ivor Raymond provide substantial and varied support which ensures the essential change of sound. And Eddie Calvert is very competent with a sure, true trumpet tone, which is smoothly modulated into the arrangements. Wisely, he is remote enough from the microphone to relieve any suggestion of hardness and to take advantage of the natural liveness of the recording situation.

The tracks cover a wide vista of devotional music but provide enjoyable listening: All In The April Evening—I'm Praying To St. Christopher—He Bought My Soul At Calvary — 23rd Psalm—All People That On Earth Do Dwell—Praise My Soul—Eternal Father —Onward Christian Soldiers—Bless This House—Battle Hymn Of The Republic —Village Of St. Bernadette—Once In Royal David's City—Away In A Manger—Hark The Herald Angels Sing—O Come All Ye Faithful—It Is No Secret—All Things Bright And Beautiful—May The Good Lord Bless And Keep You.

An unusual record and one that I think you'll like. (W.N.W.)

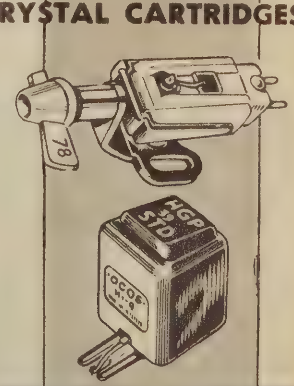
★ ★ ★

GEORGE BEVERLY SHEA Sings SOUTHLAND FAVOURITES. With the Anita Kerr Singers. Stereo, RCA Dynagroove LSP-3440. Also available in mono LPM-3440.

Interest: Shea from Nashville.
Performance: Among his best.
Quality: Excellent.
Stereo: Pleasantly spread.

Darol Rice, who produced this album, reveals that it is Bev Shea's twenty-second for RCA—surely something of a record for a Gospel singer.

It also happens to be his first from the Nashville Studios, the home of RCA's "folk" sound. Not surprisingly, Bev Shea is presented in association with the Anita Kerr singers, and with gently, rhythmic arrangements by Anita Kerr. The result is an overall relaxed atmosphere with the soloist sounding a good deal less strained than in some of his other albums.



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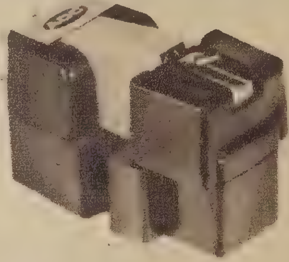

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The title "Southland Favourites" is something of a misnomer for the hymns are widely known and loved: Peace In The Valley — Precious Memories — Why Should He Love Me So — The Eastern Gate — Faith Unlocks The Door — Ship Ahoy — The Last Mile Of The Way — The Pearly White City — Sunshine In My Soul — The Rose Of Sharon — Room At The Cross For You.

Well recorded, this is an album that will appeal to all who have a special liking for this famous and dedicated Gospel singer. (W.N.W.)

★ ★ ★

MUSIC WITH A MESSAGE. The Talleys — Joe, Marian, Paul and Carolyn. With Kurt Kaiser, organ. Stereo, Word (Gospel Film Ministry) WST-8354-LP.
Interest: Gospel instrumental.
Performance: Virtuoso.
Quality: Good.
Stereo: Plenty of spread.

When members of the Talley family, some weeks ago, appeared as guests on Bob Crosby's TV program in Sydney and Melbourne, they virtually stopped the show with their instrumental presentation. In the accompanying interview, Joe Talley explained why he had turned aside from attractive professional offers to head a family-evangelistic team, which is currently touring South-East Asia.

This latest disc "Music With A Message," is a sequel to the earlier — and successful—album "Handfuls Of Music." That disc was a kind of debut for the son, Paul Talley, as an accordionist; he has since emerged as a highly accomplished player. This new disc introduces Carolyn, the youngest member of the family, as a flautist, who will probably follow the family pattern.

The numbers on the disc, most of them well known in evangelistic circles, include: Where He Leads Me — Stand Up For Jesus — Life's Railway To Heaven — The Way Of The Cross — Saviour Like A Shepherd —Does Jesus Care — No One Ever Cared For Me Like Jesus — Whosoever Meaneth Me —No One Understands Like Jesus — Song Of A Soul Set Free — Christ Arose — My Saviour's Love — The Saviour Is Waiting — Ready — Lower Lights.

Well recorded, and with full use made of the stereo facility, this is a disc which should bring a lot of pleasure to anyone interested in Gospel instrumental from dedicated performers. (W.N.W.)

Instrumental, Vocal & Humour

WHITE HORSE INN. Music by Ralph Benatzsky and Robert Stolz; lyrics by Robert Gilbert. The New World Show Orchestra and Singers conducted by Johnny Douglas. Stereo, World Record Club LM 7002.
Interest: Ever-popular musical.
Performance: Good.
Quality: Good.
Stereo: Normal.

Adapted from the play "Im Weissen Rossl" by Blumenthal and Kadelburg, the musical "White Horse Inn" draws its title from a romantic inn of that name which has long stood on the shores of the Wolfgangsee, near Salzburg. Mid scenes of splendour, gaiety and dancing, it is primarily the story of Leopold and his love for the haughty proprietress Josepha.

White Horse Inn enjoyed a highly successful season in Berlin before the decision was reached to restage it for presentation at London's Coliseum theatre. It opened there in April 1931, with a cast of 200, including Tyrolean dancers, a huge revolving stage, elaborate stage effects and another 200 people to handle the back-stage "mechanics."

It was hailed as a new era in theatre setting, a pattern for the many stage spectaculars which have followed it — not only in London but all over the world.

On this disc, Johnny Douglas and the New World Orchestra and Chorus present songs from the show, some of which stand as hits in their own right: Overture — Opening Chorus — It Would Be Wonderful — White Horse Inn — Happy Cows — Your Eyes — Goodbye — You, Too — In Salzkammergut — Sigismund — My Philosophy — My Song Of Love.

Presentation, quality and stereo are all good, making it an enjoyable album, particularly if you have nostalgic memories — as I have — of the original Sydney season at "The Royal." (W.N.W.)

ROSE-MARIE. Julie Andrews (Rose-Marie La Flamme), Giorgio Tozzi (Jim Kenyon) with the Michael Sammes Singers and the New Symphony Orchestra of London under the direction of Lehman Engel. RCA, stereo LSO-1001; also available in mono LOC-1001.

Interest: Highlights of stage musical.

Performance: Mostly good.

Quality: Varies, but generally good.

Stereo: Normal spread.

The versatile Miss Julie Andrews has proved her worth time and again, but I fear she is badly cast in this version of the famous musical of the 1920s. She sings as pleasantly as ever in her lightweight voice, but with her precise, English accent and demure style of delivery it is hard to imagine her as the Rose-Marie with "a little devil in her eye." On the other hand, Giorgio Tozzi seems ideally suited to the role of Jim Kenyon, expressing manliness effortlessly with his strong baritone voice. In the "Indian Love Call" duet his magnificent voice seems to lift Miss Andrews to new heights of vocal achievement.

The best melodies from "Rose-Marie" could easily be accommodated on one side of an L.P., but since RCA have elected to devote the whole record to this selection, they have perforce had to include some of the more pedestrian material.

There appears to be some mystery about this recording, since the sound quality is excellent in the songs sung by Miss Andrews and Tozzi, but not as good in some of the other numbers. This leads one to the suspicion that some of the material was extracted from an older recording and combined with new material made by the two principals. Or is there another explanation?

The track titles are: Overture—Rose-

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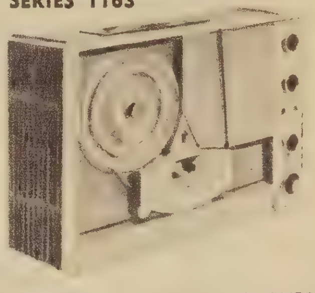

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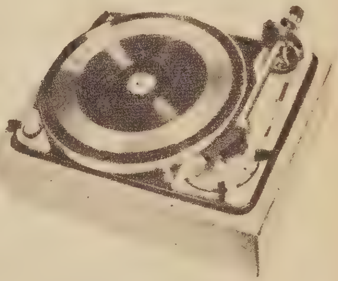

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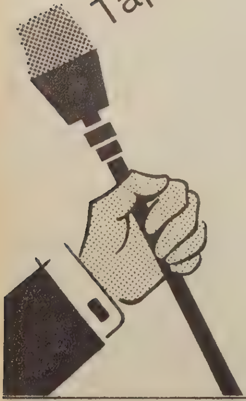

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THE JOLSON MUSICAL AUTOBIOGRAPHY. Five-Record set. Stereo, Festival SDL-931, 901-5. Also available in mono.

Interest: Old-time singing star. Quality: Dated but acceptable.
Performance: Jolson all the way. Stereo: Largely nominal.

I commented some time ago on the number of Jolson albums still in circulation, sixteen years after his death. This would be less surprising if he had been a good singer but few would claim that Jolson ever merited such a description.

But what Jolson lacked in the qualities which win eisteddfods, he more than made up in his ability to live every song he sang.

Born in Russia in 1888, Jolson's real name was Asa Yoelson, son of an itinerant cantor, who served in small Jewish churches. Much against his father's will, Asa turned his attention to the stage and gradually worked his way up through vaudeville and minstrel shows to star rating, then on to Broadway.

In 1927, Jolson made movie history with the first "talkie," later becoming one of the network idols in the golden days of radio. In 1946, when the name of Jolson might well have been sliding into obscurity, it hit the headlines again with the fantastically successful "Jolson Story," featuring the face of Larry Parkes but the unmistakable voice of Jolson himself. Another film followed the further years of popularity on radio and records.

The life story of Jolson is set out in considerable detail on the folder which comes with this set. And on the five records are nearly seventy songs, which surely must represent a goodly proportion of those with which Jolson became identified.

The songs would appear to have been collected more with an eye to the broadest possible array of titles, than to presenting any kind of historical survey. My guess is that most of them have come from Kraft Music Hall broadcasts, recorded during the later part of his career.

But please don't ask me to list them or even mention a few typical on titles. You name them — they're there!

As noted earlier, the quality is dated but acceptable. Don't expect too much of the stereo, however — it is the simulated variety. (W.N.W.)

Marie — Hard-Boiled Herman — The Mounties—Lak Jeem—Indian Love Call —Pretty Things—Why Shouldn't We —Totem Tom-Tom—Finale, Act 1—Finaletto Act 2—Minuet of the Minute —Door of My Dreams—Finale Ultimo (H.A.T.)

* * *

NUTCRACKER BALLET MUSIC. (Complete) Tschaikovsky. The Utah Symphony Orchestra, conducted by Maurice Abravanel, Vanguard — Everyman Classics (Astor) Mono, SRV-168/9. (Also available on Stereo, SRR-168/9 SD.)

Interest: Classical Ballet.
Performance: Satisfactory.
Quality: Good.

This version of the "Nutcracker" ballet music will appeal to the budget-minded, as the two-disc set can be bought for less than the price normally paid for the shorter "Nutcracker Suite" version on one disc.

Despite this, both the performance and sound quality are worthy of a "very good" classification. That the name of the Utah Symphony is not better known to record buyers is probably due to the domination of the recorded music scene by the "big names," since they prove here that they are capable of excellent playing under the experienced baton of Maurice Abravanel.

The complete "Nutcracker" takes over 1½ hours to play, but with such a stream of sumptuous melodies as are contained in the work, it is impossible to lose interest. Those who know only the suite version will probably wonder why such lovely music as the pas de deux of the Sugar Plum Fairy and her Consort, and the equally lovely "Sleep Music" are so seldom played. (H.A.T)

GREAT PIANISTS PLAY CHOPIN. Columbia (E.M.I.), Mono, 330CX 7528.

Interest: See title.
Performance: Satisfying.
Quality: Disappointing.

It has become fashionable to regard the music of Chopin as mainly for the young and the unsophisticated, and many adopt the attitude "I grew out of Chopin years ago." But some who have "grown out" of Chopin might find that the music still has some meaning for them after hearing the performances on this disc.

To be sure, this is mainly popular Chopin and most of the pieces have suffered under the assaults of amateurs and the plagiarism of popular song writers. But played here by some of the master pianists of the century, their full beauties are revealed.

Part of the fascination lies in comparing the different approaches to Chopin of the performers. While some might react to the extreme rubatos employed by Malcuzynski, others to the polished virtuosity of Horowitz, or the matter-of-fact, business-like approach of Cortot, these are purely subjective impressions. Aspiring pianists should find much to interest them in the disc, since it demonstrates how Chopin should be played, but seldom is.

The big disappointment is the generally poor sound quality, probably because E.M.I. have used mainly old recordings. While this may have been unavoidable in the case of Cortot, six of the performers are still actively recording, and the other two died in the 1950s.

On the credit side must be mentioned the quiet surface and absence of hiss, and the generous playing time

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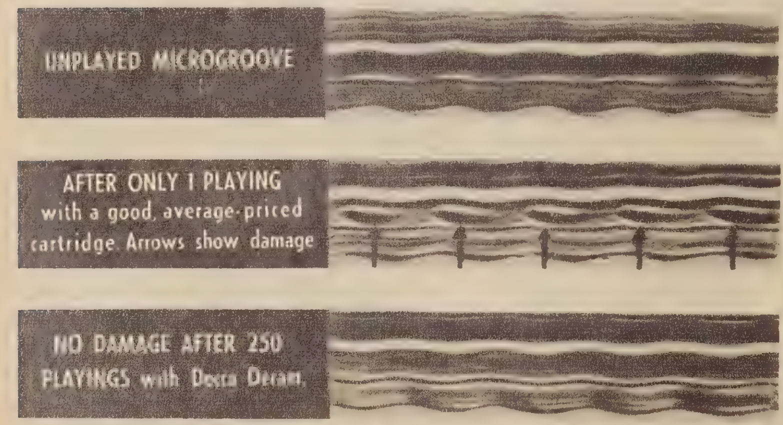
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BERCEUSE IN D FLAT MAJOR, Op. 57 (Walter Gieseking).
WALTZ No. 1 IN D FLAT MAJOR, Op. 18 (Dinu Lipatti). (H.A.T.).

* * *

OUR MAN FLINT — Original motion picture score. Music composed and conducted by Jerry Goldsmith, 20th Century-Fox (Festival) 12-inch stereo, STL-931,884. Also in mono on TL-31-884.

Interest: Movie sound-track.
Performance: In keeping.
Recording: Excellent.
Stereo Quality: Good.

A disc of the tunes from one of the recent additions to the current crop of Hollywood "007esque" adolescent erotofantasies. If you've seen the movie and liked it you will probably like the disc—otherwise it will probably seem pretty boring. It seems to me to be music which doesn't go over too well on its own.

Our Man Flint—Never Mind, You'd Love It—It's Gotta Be A World's Record—Man Does Not Live By Bread Alone—Take Some Risks, Mr Flint?—Tell Me More About That Volcano—You're A Foolish Man, Mr Flint—In Like Flint—Doing As The Romans Did—Galaxy A Go-Go, or Leave It To Flint—All I Have To Do Is Take A Bite Of Your Apple?—Stall! Stall! Flint's Alive.

If it's of interest, the recording is excellent. (J.R.)

"Calendar" is the new economy label recently announced by Festival Records Pty. Ltd., of 223-9 Harris St., Pyrmont, N.S.W. Calendar albums, for the most part, will be re-issues of discs previously sold on other Festival labels but now no longer available, featuring big-name artists and groups. Despite the modest price, $2.95, the discs will be first-grade pressings in first-grade jackets.

MANTOVANI MAGIC. Mantovani and his orchestra. Decca Stereo SKLA 4749. Also available in mono LKA 4749.

Interest: Romantic tunes.
Performance: Good.
Quality: Good.
Stereo: Normal.

Mantovani's records remind one of the saying about dragons, "once you've seen one you've seen them all." His presentation always has the same meticulous approach to detail which, once heard, is readily recognised. The arrangement of the melodies on this disc is no

S. BACH — "Almost uncanny insight . ."

J. S. BACH: Complete Trio Sonatas for Organ, Vol. 2; Six Chorale-Preludes (Schubler Collection). Marie-Claire Alain at the Maracussen Organ of the Varde Church, Denmark. Record Society 12-inch stereo, S/6184.

Interest: Classic organ.
Performance: Outstanding.
Recording: Superb.
Stereo Quality: Wide spread.

This is the second of two recordings which Marie-Claire Alain made originally for the French Erato label (STE-50030/1) covering the Trio Sonatas and the Schubler chorale-preludes, both of which have now been released in Australia by The Record Society. Mme. Alain has made a number of other recordings for Erato, but to my knowledge most of these have been available on import only.

One of the very few world-class women organ virtuosi, Mme. Alain is to my mind one of the most gifted organists in the world today; as a player of Bach she has few peers. With an almost uncanny insight into the music, a precise rubato and a delightfully crisp style, she can coax a myriad of meanings out of passages which with many organists seem quite empty.

I've never heard the Trio Sonatas played quite as successfully as she plays them on this and the previous recording. Admittedly they are difficult works to master; but this simply increases their challenge for, as Mme. Alain shows, they can be most rewarding. In her hands (and feet!) they burst forth from their supposed austerity with the full charm and beauty which the Tomascantor must have intended. Sparing and thoughtful in her registration, her precise playing keeps all parts distinct and buoyantly alive.

The little Schubler chorale-preludes she plays with similar success. Particularly delightful is BWV648, "Meine Seele erhebet . . .," while even the well-worn "Wachet auf . . ." ("Sleepers, Wake!") sounds fresh and lively.

The Marcussen organ used for these recordings is a delightful now-Baroque instrument having 34 stops on its three manuals and pedal. Its specification is shown on the disc sleeve, together with the registrations used by Mme. Alain for the various works.

The recording is in the best Erato tradition, with smooth bass and crisp transparent treble. The stereo sound is wide and smoothly spread.

From start to finish, a fascinating and completely satisfying recording. For Bach organ lovers, I couldn't give this disc a warmer recommendation. (J.R.)

exception and the feeling of the artist guiding the orchestra is quite apparent.

The titles presented are:

Misty—Red Roses For A Blue Lady—Chim Chim Cheree—Love Me With All Your Heart—Goodnight Sweetheart—Cara Mia—I Wish You Love—Lover—Stardust—Mona Lisa—The Most Beautiful Girl In The World—Auf Wiederseh'n Sweetheart.

Some very well known composers are presented in the above listing and Mantovani sprinkles a little of his magic to enhance the romance of the themes (K.W.)

* * *

BILLY VAUGHN'S HOLLYWOOD. Billy Vaughn and his Orchestra. Stereo, Calendar (Festival) SR 66-96. Also available in mono R66-6.

Interest: Rhythmic melody.
Performance: Bright.
Quality: Clean.
Stereo: Very good.

As always, this record of well-known melodies is presented in a bright manner by Billy Vaughn and his orchestra. His singing sax is figured prominently throughout the record, but without dimming the performance of the orchestra, which is characteristically smooth. It all makes for very pleasant listening.

A small surprise on this disc is the inclusion of one chorus of a well-known hymn among twelve popular tunes. Calendar is an "economy" label, retailing at $2.95, released by Festival records, but retaining the high quality expected from this company.

The titles: Theme From The Dark At The Top Of The Stairs — O Sole Mio — Never On Sunday — Old Cape Cod — The Green Leaves of Summer — The Church's One Foundation — Theme From Mr Lucky — Theme From The Sundowners — Everybody's Somebody's Fool — Walk Don't Run — Remember When — Volare — Love Is A Many Splendoured Thing.

Even without the price factor, the excellent overall quality of this record should give it wide appeal. (K. W.)

* * *

CHAMPAGNE ON BROADWAY. Lawrence Welk and his Orchestra. Dot (Festival) Stereo SZL-931,885. (Also available in mono ZL-31,885).

Interest: Broadway musicals.
Performance: Bright.
Quality: Good.
Stereo: Well spread.

As the title might suggest, these melodies could have subsidised quite a few cases of champagne for composers and artists. The arrangements here, by Bob Ballard, are very bright — even boisterous in one or two instances —

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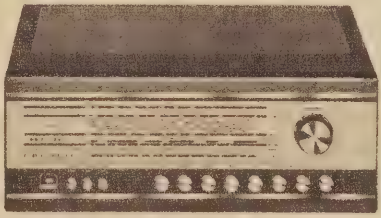

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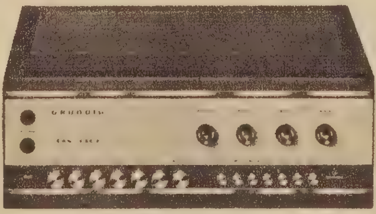

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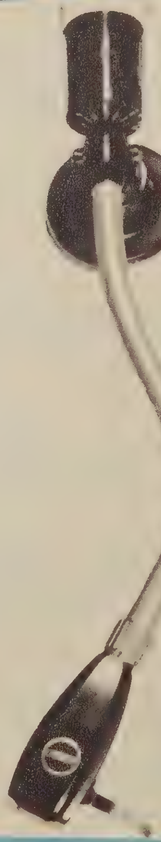

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Interest: Historic bands.
Performance: Authentic!
Recording Excellent.
Stereo quality: Convincing.

Another splendid presentation album from Reader's Digest and RCA, this time a highly entertaining and historically valuable recording anthology of the era of the big swing. There are in all 24 of the big-name bands of the 30's and 40's, playing the tunes which they made and which made them famous. Along with the names which appear on the cover as listed above, there are such bands as Bob Zurke, Xavier Cugat, Alvino Rey, Fats Waller and Bunny Berigan.

In all cases the recordings are original, processed from the masters to give the best possible reproduction on modern equipment; a stereo "broadening" effect is created by tonal filtering techniques, subtly but to good effect. It's really surprising how well most of the recordings sound; noise and distortion are everywhere quite low, and usually the only clue to recording age is reduced bandwidth (often barely noticeable).

I won't attempt to list all the titles; you can rest assured that the 72 tracks include just about all the tunes you'd expect to find in such an anthology. For example Glenn Miller is represented by such tunes as — At Last — In The Mood — Pennsylvania 6-5000 — Tuxedo Junction — Little Brown Jug.

Presentation of the discs is excellent: the stout presentation album is carefully arranged to protect them while allowing easy access, and each disc sleeve has short but detailed notes for each of the tracks. A track index on the album makes it easy to find the disc on which a tune is featured.

I couldn't find one track which was disappointing technically, from start to finish; R-D and RCA are to be warmly conmmeded for the splendid reprocessing. To those who knew and loved the swing era, what more need be said? (J. R.)

and the presentation urges the listener to be up and about.

The melodies recall such famous productions as "The King and I," "Carousel" and "My Fair Lady" and, while there is no vocal on the record, few will have any difficulty in recalling the lyrics, both romantic and humorous.

The titles on the record are:

On The Street Where You Live — I've Grown Accustomed to Her Face — I Whistle A Happy Tune — The Sound of Music — Maria — Getting To Know You — Get Me To The Church On Time — Some Enchanted Evening — It Might As Well Be Spring — On A Clear Day You Can See For Ever — If I Loved You — People Will Say We're In Love.

For moments bright and gay—recommended. (K.W.)

* * *

FLAMENCO GUITAR—Carlos Montoya. Ampar (Festival) Mono, ML-31-836.

Interest; See title.
Performance: Enthralling.
Quality: Excellent

Most adherents to the traditional (flamenco) style of guitar playing would agree that the leading exponents today are Mario Escuderos, Sabicas and Carlos Montoya.

The release of this disc has been timed to coincide with the Australian tour of Montoya. He is a true flamenco player—that is, his playing has an improvisatory quality, but strictly based on the traditional flamenco rhythms and chord structures. This is a most enjoyable performance, executed with great skill.

The recording is very good, care having been taken to avoid the clicks and squeaks of the plectra on the strings which can be so disturbing in guitar recordings. This is perhaps not surprising, as Ampar have made something of a specialty of recording guitarists.

A surprising feature of the program chosen by Montoya here is that it does not include a farruca, a seguidillas, a fandango, a malaguena or a bulerias. Without any of the these forms, which many would regard as the mainstays of the flamenco art, one might be tempted to wonder what is left for a flamenco recital. Never fear! Montoya still has plenty of tricks up his sleeve, and with the remaining traditional titles of Huelva, Zambra and Zapateado, etc., he brings in a few of his own.

Here is the full list of titles: Huelva—Guajiras — Zapateado — Alorno y Verdial — Zambra — Rondena —Cafe de Chinitas — Variaciones de Cadiz. (H.A.T.)

* * *

GREAT TV AND MOVIE SPY THEMES. Dick Hyman and his Lowrey organ. Stereo, Command (Festival) SNDL-31,907. Also available in mono.

Interest: "Organised" combo.
Performance: Competent.
Quality: Good.
Stereo: Plenty of separation.

Though Dick Hyman and his Lowrey organs monopolise the large type on the jacket, this is by no means a solo performance. He is ably supported by a group of Command's well known musicians, to the tune of three guitarists, three percussionists and a bass. By the time they have all added their contribution to a lead organ, which is used largely in an imitative role, it is not always immediately obvious who is doing what.

In a way, this is a backhanded compliment to Dick Hyman for his ability to become so much a part of an instrumental combination; it is also a warning to those who might be looking for organ solos of the more conventional kind.

In fact, this presentation is in the familiar Command pattern, with a group

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* * *

SPANISH GUITAR MUSIC. Jose Luis Gonzalez. CBS Masterworks 12-inch mono, BR-235147.

Interest: Spanish guitar.
Performance: Restrained but fine.
Recording: Excellent.

This is the latest recording from guitar virtuoso-tutor Jose Luis Gonzalez who, as most will be aware, has been resident in Australia since 1962. And as we have come to expect from Snr Gonzalez, it is a highly enjoyable musical experience. Although perhaps a trifle restrained in one or two pieces, the overall effect is nevertheless one of tremendous confidence and warmth.

The pieces played are an Albada, an Arada and Fandanquillo, by Torroba—Two Estudios, by Segovia — Campanas Del Alba, by Eduardo de la Maza — Tango in D, by Albeniz — Homenaje, "Pour le Tombeau de Debussy," by de Falla—Zapateado and two Estudios, by Regino de la Maza—Soleares, by Turina —Zambra Granadina and Mallorca, by Albeniz—Danza No. 5, by Granados.

The works by Albeniz and Granados are quite well known and loved, even if not by name; because of these alone the disc should have a wide appeal. However to me the real gems on it are the delightful little pieces by Eduardo and Regino de la Maza; in these the instrument really seems to sing.

The recording quality is excellent throughout. Thus I have no hesitation in giving this disc every recommendation. (J.R.)

* * *

BRENDAN. Brendan O'Dowda with Norrie Paramor and his orchestra. Columbia (E.M.I.), Mono, 33OSX-7759.

Interest: Irish songs.
Quality: Good.
Performance: Pleasing.

Irish songs are renowned for their lyricism and wit, and their fame beyond the boundaries of the Emerald Isle is largely due to the great Irish tenor, the late John McCormack. Brendan O'Dowda is not another McCormack, as hinted at in the sleeve note, but sings very well in a pleasing voice with a light brogue, very well suited to the songs presented on this disc.

The first song on the disc is the enchanting "Kitty of Coleraine" which I have long regarded as one of the best examples of Irish folk songs. After this, the following songs seem something of an anticlimax, but the first side ends with another great favourite "Galway Bay." Apart from these two, and the equally well-known "Killarney" on the second side, the songs selected by O'Dowda are lesser known, but they all make very pleasant listening.

The recording was made in 1959, and no doubt E.M.I. have their own reasons for waiting seven years before releasing it here. Inevitably the sound quality suffers in comparison with current recordings and, for this reason, does not get an "excellent" rating. Apart from this slight qualification, I can recommend this very enjoyable disc to those with a taste for Irish songs.

Here is the full list of tracks: Kitty of Coleraine — Queen of Connemara — Glen Dun — By the Short Cut to the Rosses — My Girl From the West County Louth — Galway Bay — My Kilkenny Colleen — Little Mary Cassidy — The Castle of Dromore — The Ole Boreen — Killarney — The Green Bushes. (H.A.T.)

* * *

JULIE ANDREWS SINGS, with Irwin Kostal and his orchestra. RCA 12-inch stereo, LSP-1681; also available in mono LPM-1681.

Interest: Songs by popular composers.
Performance: Good.
Quality: Good.
Stereo: Effective.

Julie Andrews, well known through her appearance in such shows as The Boy Friend and Sound of Music, presents on this disc a collection of songs by some of the well known tunesmiths of Tin Pan Alley. Composers represented are Arlen — Berlin — Carmichael — Coward — Gershwin — Kern —Lerner-Loewe — Novello — Porter — Rodgers-Hart — Rodgers - Hammerstein and Weill.

The musical arrangement is well handled by Irwin Kostal and Julie Andrews' performance is very good. The clear diction and bell-like tones of the singer's voice add a touch to the well-known melodies featured which will delight many listeners. Julie Andrews has a happy knack of presenting the personality written into the song by the composer. This affinity of mood is clearly present in the presentation of the melodies on this disc.

The tunes featured are: It Might As Well Be Spring—Falling In Love With Love—We'll Gather Lilacs—He Loves And She Loves—I'm Old-fashioned—You're a Builder-Upper—Little Old Lady —My Ship—Cheek To Cheek—Come To Me- Bend To Me—So In Love—Matelot. (K.W.)

* * *

THAT GOOD GRADY, Grady Martin, his guitar and the Slewfoot Five. Stereo, Calendar (Festival) SR66-95. Also available in mono R66-5.

Interest: Swinging pop.
Performance: Fair.
Quality: Good.
Stereo: Normal.

This is a record which should appeal to the younger set for the excellent in-the-groove presentation on side one. Lively piano, sparkling sax and smooth guitar, with a certain air of gay abandon may even smooth some of the corners off the older "squares." By way of contrast the second side is devoted to rhythm style and, while this may appeal to others, left this reviewer somewhat less enthusiastic.

This disc is on an economy label produced by Festival, retailing at $2.95, but in no way does the quality of the recording reflect the low price. For those who like the music, it is good value for money.

The tunes featured are, Side one: Hey Chick — Tuxedo Junction — All The Way — Don't Take Your Love From Me — What's The Use — Keep It Movin'; Side two: Ramblin' Rose — Tippin' In — The Fuzz — Good, Good, Good — Big Bad Guitar — Twist and Turn. (K.W.)

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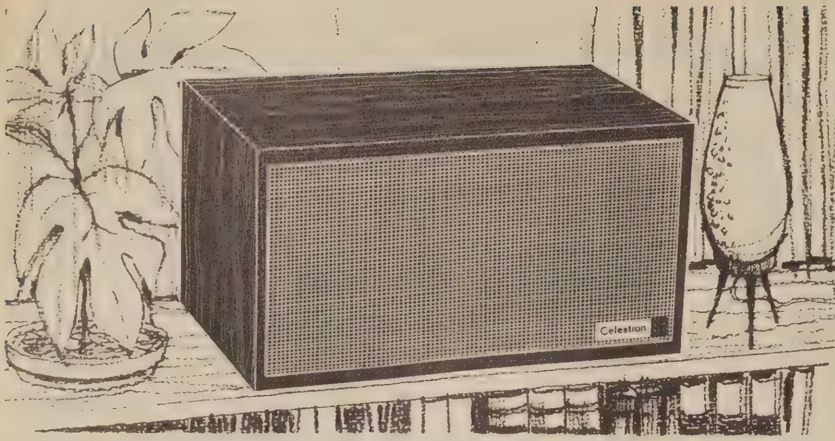

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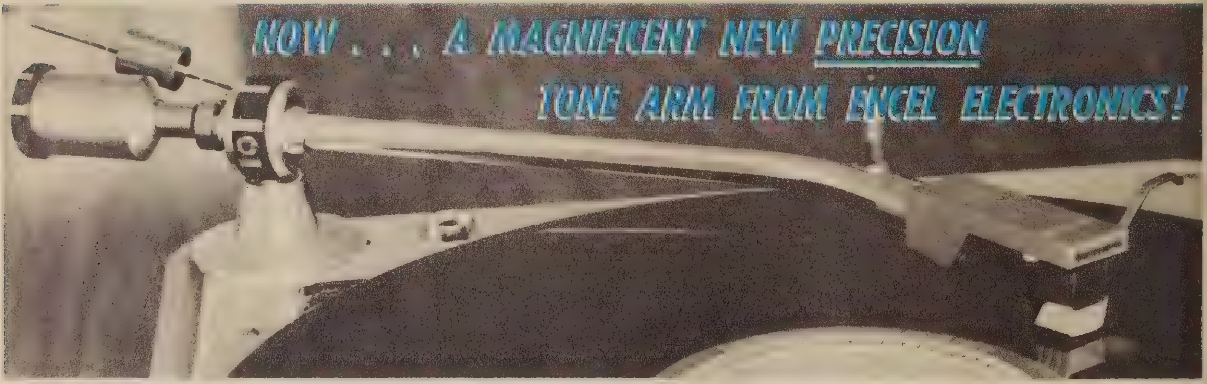
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THE RAY CHARLES SINGERS ON BROADWAY, produced by Enoch Light, Stereo, Command (Festival) SNDL-931, 880. Also available in mono NDL-31, 880.
Interest: Broadway hits.
Performance: Good.
Quality: Good.
Stereo: Normal.

The artist — or group — who sets out to present an album of Broadway hits automatically invites comparison with the "original" presentations and it is all to easy to be judged the "second best."

I could not escape the feeling with this particular disc even though, to give credit where credit is due, the performance is quite entertaining. To be certain, the singers are backed by some very able musicans —Dick Hyman on organ and piano, Tony Mottola guitar, Bob Haggart bass, Bob Rosengarden drums and Al Casamenti as second guitar.

Romantically inclined, the melodies presented are: Consider Yourself — On A Clear Day You Can See For Ever— She Loves Me — Try To Remember — Mack The Knife — Who Can I Turn To — Wouldn't It Be Loverly — Matchmaker, Matchmaker — If I Ruled The World — If The Rain's Got To Fall — Till There Was You —Tonight. (K.W.)

* * *

SWEET MUSIC AND MEMORIES. Billy Vaughn and his Orchestra. Dot (Festival) Stereo SZL-931,906. Also available in Mono, ZL-31,906.
Interest: Dance Music·
Performance: Dreamy, nostalgic.
Quality: Very good.
Stereo: Wide, even spread.

Billy Vaughn goes all sentimental in his performances on this disc, and very pleasant it sounds too. Every second number is a dreamy slow waltz, while the intervening numbers are mainly quicksteps with nostalgic titles. Otherwise the recipe is much the same as before, with Billy coming to the fore to take the lead with his smooth brand of sax playing. A nice disc for a quiet evening at home, or for mood music on appropriate occasions.

The sound quality is excellent while, with properly spaced speakers, the stereo separation adds a nice touch of realism. Melody of Love — Joyride — Silver Moon — Baby O' Mine — The Waltz You Saved For Me — Billy Vaughn's Boogy — Missouri Waltz — Lovely You — Tennessee Waltz — Naughty Annetta — Drifting on a Cloud — Morning, Noon and Night. (H. A. T.)

* * *

EXOTICA. Manuel and the music of the mountains. Columbia (EMI). Mono 330SX 1770. Also available in stereo SCX 1770.
Interest: Latin-American.
Performance: Fair.
Quality: Good.

This is one of the times a book—or record—should not be judged by its cover. The melodies listed are well known and, if presented in an expected manner, should provide good entertainment. However this reviewer's reaction was one of disappointment for, while some tracks could pass muster, arrangements in other tracks were not to my liking at all.

The titles presented are: Exotica—Autumn Leaves—Sabara—Cherry Pink And Apple Blossom White — Duck—Forget Domani—Tico Tico—La Vie En Rose—Life Goes On—The Dancers of Delphi—Two Strangers Met—Blood and Sand.

I'll stay on the plains (K.W.).

POPULAR JAZZ

Reviewed by GRAEME BELL

FATS WALLER, VALENTINE STOMP. R.C.A. Vintage Series, Mono LPV-525.
Interest: Stride Piano.
Performance: Excellent.
Quality: Very Good.

This is an excellent remastering of a variety of offerings from that exuberant pianist-vocalist-composer Thomas "Fats" Waller. His influence in the history of jazz was unique because he was able to capture the popular markets through his singing, humour, and hit compositions, while retaining a hot jazz sound.

Tracks have been expertly chosen from recordings made between 1929 and 1936, and include regular Waller sidemen such as Herman Autry and Gene Sedric.

Among the 16 tracks are three previously unissued performances, viz. — "Black Raspberry Jam," "I've Got a Feeling I'm Falling" and a wild 13-piece band version of "I Got Rhythm."

The quality of Fats Waller's recorded piano playing in the thirties never ceases to amaze me—it always sounds like a piano rather than a reproduction of a piano sound.

* * *

DUKE ELLINGTON, JUMPIN' PUNKINS. R.C.A. Vintage Series, Mono LPV-517.
Interest: Ellington.
Performance: Excellent.
Quality: Good remaster.

Here is a collection of 16 sides from the 1940/41 band, considered to be a peak in Ellington's career.

It is handy for the Ellington lover to have such well-known classics from this period as "John Hardy's Wife," "Dusk" and "Jumpin' Punkins" on the same album as some of the lesser-known items such as "Clementine" and "Chocolate Shake."

All the great Ellington performers are there, including Rex Stewart, Cootie, Ben Webster, Hodges, Joe Nanton and the late Jimmy Blanton. ■

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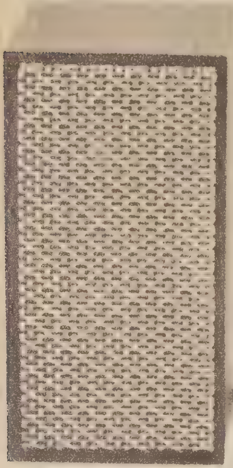

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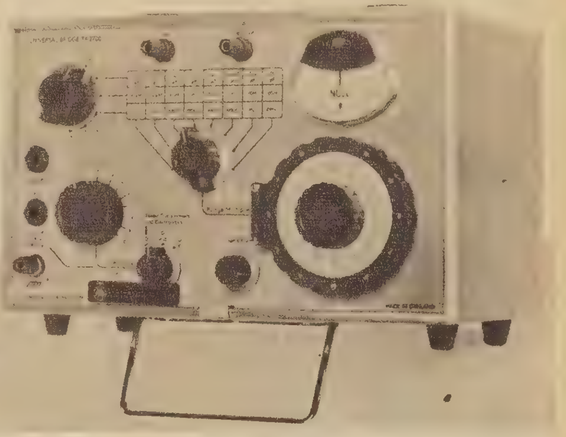
TRADE REVIEWS AND RELEASES

NEW MARCONI BRIDGE

A recent addition to the range of measuring equipment manufactured by Marconi Instruments is the Universal Bridge type TF-2700. Fully transistorised, the instrument is compact and self-contained and provides for a very comprehensive range of measurements on resistors, capacitors and inductors. The instrument was sent for review by the sole agents for Marconi in Australia, Amalgamated Wireless (Australasia) Ltd.



The TF-2700 measures only 11½in x 8in x 8in and weighs a mere 8lb. The stout aluminium case is finished in two-tone grey lacquer, with an attractive panel escutcheon in brushed aluminium extrusion. A rack is thoughtfully provided at the rear of the case for the instruction manual, to reduce the risk that the latter will "stray."

The instrument provides for both DC and AC bridge measurements for resistance, and AC bridge measurements for capacitance and inductance. Eight value ranges are provided for each of the R, L and C functions; in conjunction with a multiplier switch calibrated in "x0.1" steps and a vernier dial graduated in "x0.002" divisions, this allows measurements of from 0.5pF—1100uF, 0.2uH—110H, and 10 milliohms to 11M.

Loss balance controls are provided, calibrated at 1KC to allow determination of Q from 0—10 or D from 0—0.1 and 0—10. A sensitivity control is provided, and the internal AC bridge source operates at 1KC.

On the AC measuring ranges (L, C and R) direct voltage or current may be applied to the test component for polarisation or saturation checks, etc. Up to 500V may be applied and up to 40mA passed through the jacks provided for this purpose. In addition external DC and AC bridge energising may be applied on all ranges as appropriate; the AC bridge detector has a usable response from 20cps — 20KC.

The basic accuracy of the instrument is quoted as ±1 per cent of the reading ±0.1 per cent of the range full scale. The inductance ranges have an additional +0.2 per cent of reading, —0—0.3uH. The first ranges of each function have approximately 2 per cent final accuracy. Residuals to be subtracted are 0.2pF for Co, 0.2uH for Lo and 2 milliohms for Ro.

Checked out in our laboratory these specifications proved to be quite easily met by the review sample. Out of curiosity we also tried measuring an office paper clip, as Marconi suggest in one of their recent advertisements. This is admittedly a hard test, but the TF-2700 proved quite able to arrive at a credible result.

Bridge balance indication is via a small centre-zero meter, mounted in the familiar Marconi inverted position. For DC measurements the meter indicates in both directions, while on the AC ranges it moves only to the right as a result of the detector circuitry employed. In all cases the indication is easily observed and unambiguous.

Other noteworthy points about the instrument: the tilting foot or "bail," which allows convenient bench-top operation; the panel terminal markings which permit the instrument to be used with external detectors, or to be used as a detector for external bridges (there is also a convenient earth terminal for measurements with a "guard"). Also the rear-case battery compartment, which is thoughtfully made from plastic to guard against corrosion, and the simple but cunning "pilot lamp" (a piece of luminous red tape unmasked by the function switch) which while quite effective does not contribute to battery drain.

Incidentally the battery for the instrument is a medium-sized 9V type, which should have a long life at the average drain of only 7mA. The battery type is not a well-established one in this country, but supplies are apparently now obtainable through the usual trade outlets.

Price of the TF-2700 is quoted at $225.00 plus sales-tax where applicable. Inquiries should be directed to the Engineering Products Division of Amalgamated Wireless (Australasia) Ltd., at 47 York Street, Sydney. (J.R.)

KITSET FOR ALL-WAVE RECEIVER

A.C.E. Radio recently announced the introduction of the JR-200 "communications receiver" kitset. A sample of this kitset was examined in our laboratory and, for the price quoted, could be quite a proposition for the home constructor cum short-wave listener. The frequency range covered is 550KC to 31MC in four bands with bandspread on a logging type dial scale.

The kit comes "complete to the last nut and bolt," no additional components or metalwork being necessary. Mechanical construction is quite sound, heavy-gauge metal being used throughout and well finished. The front panel is recessed behind a rolled lip on the front of the case, which is made in two sections for easy access. Lettering on the front panel is painted, not engraved, but should withstand the normal wear and tear. The chassis is steel with cadmium plating, passivated to give good resistance against corrosion.

Heart of the kit is undoubtedly the tuning gang assembly, the fully calibrated dial system and the prefabricated 4-band coil unit — the last-named in particular being a most workmanlike unit. Such units are no longer available from Australian manufacturers.

The kit builds up into the equivalent of a standard commercial receiver. It could conceivably be reworked into something more pretentious if the constructor has the necessary background.

The major components of the kitset are already mounted, including the tuning capacitors and dial mechanism. All the constructor has to do is to run the actual wiring and solder in the resistors and capacitors. A very clear step-by-step instruction sheet is included and the above components are on clearly identified cards in the order of insertion into the kitset. There is even a scale provided with the instructions, which may be used to cut the hookup wire to the correct lengths!

The power cord that came with the sample kit was a twin-conductor type but this will be supplemented in future kits, we understand, with a regular 3-core flex and plug. The original flex and plug will be left with the kitset, since it may be used with the "remote" socket on the rear apron for transmitter control.

The receiver is designed for use with loudspeakers of about 8 ohms impedance.

The circuit has one RF and one IF stage with mixer and separate oscillator, but no power supply regulation. It incorporates a BFO, a simple noise limiting detector and an S-meter arbitrarily calibrated in S points. The "function" switch allows for remote control of a transmitter through the socket mentioned earlier.

In this original form, the receiver should give good sensitivity, when properly aligned, but selectivity would probably be sufficient only for general broadcast and short-wave listening. It would probably not be equal to the demands of a "communications" situation.

The possibility remains, however, of using the kit as the basis for a more pretentious circuit, within the limits of chassis space and power supply rating.

The purchase price of the JR-200 receiver kitset is $89 and it may be obtained from A.C.E. Radio, 136 Victoria Road, Marrickville. (K.W.)

HANSEN METERS

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Sensitivity: DC-33,000 opv
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Volts: DC-0 to 3000 (7 ranges)
AC -0 to 3000 (8 ranges)
Current: DC:0-300uA (2 ranges)
0-300mA (3 ranges) O-12A (2 ranges) AC: 0 to 12A (2 ranges)
Ohms: 0-200K 0-200 Meg (4 ranges)
Capacity: O-2000uF (5 ranges)
Inductance: 0-10,000H (4 ranges)
GM: 0-20,000 umhos
Decibels -28 to + 58 (6 ranges)
RF Volts: 0-1200 rms (4 ranges)
0-3500 p-p (4 ranges)

MODEL M70
PRICE: $81.50
plus Tax F.OR. Sydney

Sensitivity: DC:20,000 opv
AC:5,000 opv.
Volts: DC:0-700 (7 ranges)
AC:0-700 (6 ranges)
Current: DC:O-50uA, 0-7-140mA
Ohms: 0-5-500K: 0-50 Megs.
Capacity: 0-0.03 - 0.6 uF
Inductance: 0-5-500H
Decibels: -20 to +59
RF Volts: 0-14 rms: 0-40 p-p

MODEL FN
PRICE: $31.50
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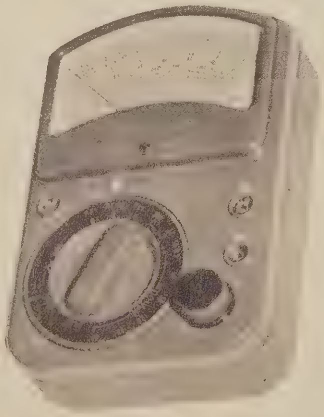
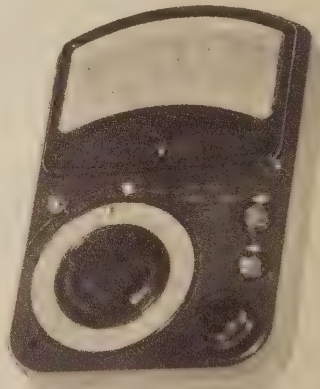


Sensitivity: DC:20,000 opv.
AC:10,000 opv.
Volts: DC:0-600 (6 ranges)
AC:0-600 (4 ranges)
Current: DC:0-50uA-12mA-300mA
Ohms: 0-10K: 1-10-100 Megs
Capacity: 0-0.03-0.6 uF
Inductance: 0-5000H
Decibels: -15 to +58
S Meter & Tube Emission Tests

MODEL SM
PRICE: $19.00
plus Tax F.OR. Sydney



Sensitivity: DC:6000 opv.
AC:2,700 opv.
Volts DC:0-600 (5 ranges)
AC:0-600 (4 ranges)
Current DC: 0-300uA: 0-12-300mA
Ohms: 0-20K:0-2-200 Megs
Capacity: 0-0-1-0-2uF
Inductance: 0-1000H
Decibels: -15 to +58
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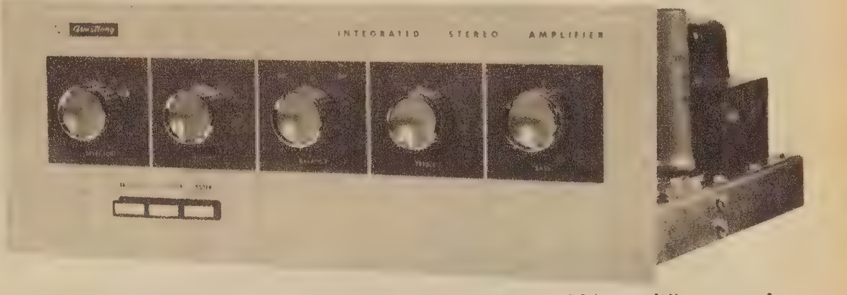
ARMSTRONG INTEGRATED STEREO AMPLIFIER MODEL 221

The Recorded Music Salon, of 23 Collins St., Melbourne, announce release of the model 221 integrated stereo amplifier, produced by Armstrong Audio Ltd., of Warlters Road, London, N7. The amplifier is being offered as a worthy companion unit for other high fidelity equipment distributed by the Recorded Music Salon.



A front view of the Armstrong 221 amplifier, as submitted for assessment. The perspex front panel is neat and functional. The colour scheme is light grey background, olive rectangles and mid-grey knobs.

Physically, the amplifier is built up from several sub-assembly panels, attached to a base frame and suitably interconnected. The unit is obviously designed with a view to mounting in existing hi-fi furniture or alternatively fitting into a free-standing case. Wiring and components are readily accessible for test and service, although the assembly is rather less rigid than would be a single solid chassis.

This impression is compounded to some extent by the perspex control panel, which is supplied separately, for attachment to the face of the cabinet in which the amplifier may be housed. In fact, this approach has much to commend it to the person who wants to build-in the amplifier, since he is spared the problem of how to dress the large cutout, which becomes necessary, when the escutcheon is a fixture to the chassis.

Electrically, the 221 amplifier is a logical extension from the earlier 222 unit. It involves the same basic valve amplifier, which is quite like the basic valve-type "Playmaster" designs, featured from time to time in this journal.

A single multi-bank switch on the front panel allows signal to be selected from stereo or mono pickup input, radio input or tape input, the latter assuming the use of an external tape preamplifier or a complete tape recorder with appropriate signal output facilities. Manufacturer's literature quotes the sensitivity of these input channels as 80mV minimum for full power output, a figure which we verified.

After selection, the signal passes to an ECC83 twin triode in each channel. Associated with this valve are continuously variable bass and treble controls, arranged in "passive" circuitry, a balance control and a volume control which feeds the basic power amplifier.

Output jacks for tape recording are connected directly to the "hot" ends of the stereo volume controls. No isolating resistor is provided at this point, so that care would be necessary to ensure that external cables and circuitry did not prejudice the signal passed to the main amplifier.

The main amplifier itself is a quite conventional push-pull arrangement. In each channel, the triode portion of an ECL86 (6GW8) serves as a voltage amplifier, driving a pentode section directly. The second triode section inverts the phase, in a floating paraphase configuration, for the remaining ECL86 pentode.

Surprisingly, the output valves are used in straight pentode connection—not ultra-linear—and the output transformers have simple, tapped secondaries to provide for load impedances of 4, 8 and 16 ohms.

Feedback is taken from the 16-ohm tapping to the cathode of the voltage amplifier, with the usual phasing capacitor and step-circuit included as a precaution against instability.

The new 221 amplifier differs mainly from the earlier 222 unit by virtue of a solid-state preamplifier introduced between the normal pickup input jacks and the selector switch previously mentioned. The preamplifier involves two NPN silicon transistors in each channel, powered from the main amplifier supply and with feed-back type compensation to suit magnetic pickups. Input sensitivity for this purpose is quoted as 3.5mV for full output, with an input impedance approximating 50K. In fact, we found the system to be rather more sensitive than claimed.

In addition to the matters mentioned, the 221 amplifier incorporates a rumble filter, selected by a slide switch on the rear of the chassis, which attenuates the bass gradually below about 100cps, by modifying the coupling into the basic amplifier.

On the front panel are three push-buttons. One introduces bypass capacitors on either side of the triodes following the tone controls, which roll the response fairly steeply beyond 8KC. A second push-button modifies the signal paths around the volume controls, which are tapped in the case of the 221, to produce a loudness contour suitable for low level listening.

The third button provides an additional monitoring facility of special use when an associated tape recorder has off-the-tape monitoring facilities.

Tested into a 16-ohm resistive load the amplifier delivered just about the neat 10 watts per channel at 1000cps at the point of clipping. The figure diminished slightly to just over 9 watts at 50cps and increased to about 11 at 10KC.

Into a 4-ohm load, with just half the secondary winding is use, power output remained unaffected at 50 and 1000cps but diminished to about 6.5 watts at 10KC, doubtless because of some leakage reactance between windings. With typical program material, this reduction in high frequency power output is not likely to be significant and, in any case, applies only to the 4-ohm case.

To check frequency response of the valve section, input was fed to the "Radio" socket and the treble and bass controls adjusted to produce level response over the audio range. This condition, involving variations of no more than a fraction of a decibel, occurred with the bass control at "0" and the treble control "+1."

From the positions, as noted, the treble control offered a variation of +14 to —9dB at 10KC, while the bass control varied the response at 50cps within the range +12 to —12dB.

Again, from the level position, the 3dB "down" points occurred at 25cps and 30KC. (All the above readings were taken with the "scratch" and "rumble" filters out of circuit.)

Square-wave tests performed through the basic power amplifier (signal fed to the volume control slider) gave a virtually copy-book wave at 1KC but a markedly rounded wave at 5KC, suggesting a fairly severe step-circuit action. This was confirmed by a large apparent tolerance, which the amplifier exhibited to parallel capacitance across the load resistor. There should be no risk of supersonic oscillation under any likely load conditions.

On test with a typical magnetic pickup, the amplifier performed very well, with ample gain, no sign of input circuit overload on peaks of signal and a commendably low level of background hum and noise with the volume control in a typical operating position. All controls operated very smoothly, adding up to a unit which is very easy and very pleasant to use.

In short, a hybrid amplifier of fairly conventional but "safe" design, with adequate facilities for domestic high fidelity installations and capable of excellent results.

New Components from AWV

AMALGAMATED WIRELESS VALVE CO. PTY. LTD. has announced availability of the following new products.

High reliability silicon NPN power transistors, Type 40366, 40367, 40368 and 40369, for power switching and amplifier applications in industrial and military equipment. The 40366, a triple-diffused silicon NPN planar type, in JEDEC TO-5 package, has a power dissipation capability of 5W. The 40367 is a silicon NPN hometaxial type in JEDEC TO-5 package, and has a power dissipation capability of 5W. The 40368 is a silicon NPN hometaxial type in a JEDEC TO-8 package with a power dissipation capability of 25W. The 40369 is a silicon NPN hometaxial type in JEDEC TO-3 package and has a dissipation capability of 75W.

RCA Industrial NPN Power Transistors, Types 2N3878, 2N3879 and 40375. These are all epitaxial high-current transistors. The 2N3878 and 40375 are amplifier types intended for audio, ultrasonic and RF circuits. Type 2N3879 is a switching transistor intended for use in high-current, high-speed switching circuits. Type 40375 has an attached heat radiator and is intended for printed wiring board mounting.

RCA Industrial Silicon NPN "Overlay" Transistor. This is an epitaxial silicon NPN planar transistor employing an advanced version of the RCA "overlay" emitter-electrode design. It is intended for Class A, B or C amplifiers, frequency multiplier or oscillator circuits, and may be used in output, driver or pre-driver stages in VHF and UHF equipment.

Also from AWV comes news of a range of vacuum variable capacitors suitable for transmitter applications up to 27MC. The standard range employs shaft tuning, but most types can be modified for axial pull tuning. AWV says these capacitors are particularly suitable for the modernisation of older transmitters.

Inquiries should be addressed to Amalgamated Wireless Valve Company Pty. Ltd., Private Mail Bag, Ermington, N.S.W.

Public Address Amplifiers

Models PA 35 and PA 65

These amplifiers are intended to cover a large range of requirements where reinforcement of speech and/or music is required. They are eminently suitable for installation in clubs, conference rooms, restaurants, hotels, etc.

TECHNICAL SPECIFICATIONS

	PA 35	PA 65
Nominal power	35 watts	65 watts
Peak power	40 watts	70 watts
Microphone sens.	3MV (100K ohms)	As PA 35
Pickup sens	125MV (1 megohm)	"
Tone control	Minus 20DB at 10KC	"
Response	30-17,000 CPS + 3DB	"
Noise	Minus 60 DB	"
Inputs	1 microphone/ 1 pickup	"
Provision for	50 ohm Input	"
Output impedence	100V Line (330 ohms)	"
Regulation	3 DB	"
Valves	Two 12Ax7 Two 6DQ6B	"
Rectifier	5 x IN3194 Silicon Diodes	" As PA35
Fuse	2 amp.	2 amp.
Dimensions	16" x 9½" x 6½"	As PA 35
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PA 35 $117.25
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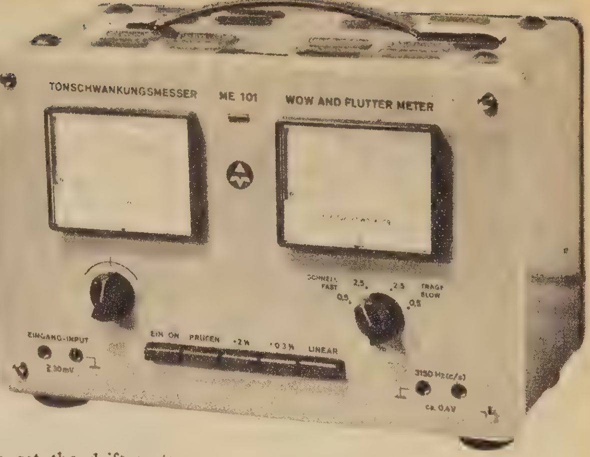
Wow and Flutter Meter

From the Technical-Physical Laboratories in Western Germany comes this "Miniflux" ME-101 Wow and Flutter Meter, a fully transistorised instrument eminently suitable for use in laboratories and advanced servicing organisations. It was sent for review by the Australian agents, Jacoby, Mitchell and Company Pty. Ltd.



The ME-101 "Tonschwankungsmesser" is suitable for checking wow, flutter and average speed drift in many types of recording and reproducing equipment, including tape recorders, gramo turntables and motion picture machines. It has been designed to be easily and rapidly used, and would be quite suitable for production testing by non-technical personnel.

For those not familiar with the meaning of the terms "wow," "flutter" and "average speed drift" or with the instruments used to measure these, it should be explained that all practical recording and reproducing equipment exhibits unavoidable speed variations which cause the pitch of the reproduced signal to differ from that of the original. The better the equipment, the smaller these speed variations and the smaller the pitch deviations, but they are always present in some degree.

The extent to which the reproducing speed differs by a more or less fixed amount from the recording speed is termed the average speed drift. As this drift will result in the average pitch of a reproduced signal being different from the original, it can be measured by recording a tone of known frequency and noting the difference in frequency after recording and replay. The average drift is usually expressed as a percentage of the original tone frequency.

Quite apart from these "fixed", or more strictly long-term speed variations, there are short-term variations which result in a noticeable—or potentially noticeable—frequency modulation of the signal. When these variations are predominantly of a very low frequency nature (about 0.5-5cps) they are termed "wow"; when of a higher frequency they are termed "flutter." Both words seek to describe the subjective effect as far as the listener is concerned.

The ME-101 is intended to operate at the standardised measuring frequency for wow and flutter testing, which is 3150cps. Thus it may be used with test discs and films having a tone of this frequency, while for tape measurements there is a tone oscillator built into the instrument (output at 800 ohms impedance, approx. 400mV). However, if the only test discs or films available to the user are based on the alternative tone frequency of 3000cps, the ME-101 can be recalibrated to suit.

The input terminals of the measuring section accept signals within the amplitude range 30mV-30V, at an impedance level of greater than 10K. After passing through amplifiers, filters and limiters the signal is demodulated in an FM slope detector. The DC component of the demodulated signal is then used to actuate the "per cent drift" meter, which is calibrated for ± 4.5 per cent. The AC components are further amplified, passed through an optional CCIR/DIN weighting filter and fed to a peak detector which actuates the "per cent wow and flutter" meter. The latter is provided with two ranges, calibrated 0-0.5 per cent and 0-2.5 per cent full scale.

The readings given by both meters are normally full-wave peak, but additional time-constants may be added to produce average readings. The CCIR/DIN weighting filter may be shorted out by pressing a "linear" button, in which case the response of the wow and flutter measuring section is 0.5-500cps (—3dB).

Built into the instrument are three calibration checks. By pressing the "prufen" (test) button, the inbuilt oscillator is connected directly to the measuring section. This allows the user to set the drift meter to zero, cancelling out instrument drift. Then by pressing another button the oscillator frequency is shifted by a known + 2 per cent, allowing the drift meter calibration to be checked. And finally, by pressing a third test button (along with the test and linear buttons) the inbuilt oscillator is frequency modulated to correspond to 0.3 per cent wow and flutter. This allows the user to check and possibly adjust the calibration of the second meter.

At the rear of the instrument are output terminals to allow the amplified wow and flutter components to be viewed on an oscilloscope. In addition, there is provided a socket to allow the use of external weighting filters, if these are desired, and a DIN connector to allow single-cable connection to tape and disc equipment which is provided with a similar connector.

The instrument is quite compact—7in x 8in x 11¾in—and being transistorised is a modest 5Kg (approx. 11lb) in weight. It is attractively presented in a two-tone grey lacquered case, with two attractive and easily read meters. Control layout is most convenient, and operation is quite easily mastered.

In tests which we carried out the ME-101 proved to be unambiguous in its readings, which checked quite well with the known performance of the items of equipment used for testing. It would thus seem to us to be a most attractive and efficient instrument, representing excellent value at the quoted price of $320.

Inquiries should be directed to Jacoby, Mitchell and Company Pty. Ltd., at 469-475 Kent Street, Sydney. (J.R.)

PORTABLE MEGAPHONE AND SIREN

An electronic siren which, at the peak of its sound, can be converted instantly to a megaphone, is one of the latest devices available for police and other emergency services.

CONVOY INTERNATIONAL PTY. LTD., recently submitted a sample of their "Sirophone" combined loud-hailer and siren for inspection in our laboratory. This unit may be carried with a shoulder strap or mounted on a vehicle for mobile applications. The separate microphone with integrated control switch allows semi-remote operation. The Sirophone is well finished in appearance and designed for weatherproof operation.

A push-button control on the horn of the unit produces a rising siren note which carries over long distances. A second push on this control immediately switches off the siren and prepares it for spoken communication. The maximum power claimed by the manufacturers is 16 watts, and the fidelity for speech appeared quite adequate when tested in typical locations.

The total weight of 5 pounds, complete with batteries, should allow the unit to be carried for long periods without fatigue. When not in use, the microphone slips into a padded clamp on the body.

The batteries used are 8 medium size cells, such as Eveready type 835. With the intermittent type operation expected with this type of transistorised megaphone, long life could be expected from these batteries.

The only genuine criticism that we can make of this unit is the lack of an on-off switch. This function is combined in the press-to-talk button on the microphone which could lead to accidental switching on and flattening of the batteries.

The Sirophone is available for $132, retail, from Convoy International Pty. Ltd., 449 Kent Street, Sydney. (K.W.).

TRANSISTOR SERVICE

ALL JAPANESE MAKES

REPAIRED

including . . .

Aristone	Aurora	Belair
Berlin	Crown	Fujiya
General	Hitachi	Kenco
Mariner	Mitsubishi	Nanaola
National	Nivico	Sanyo
Sony	Spica	Standard
Sharp	Toshiba	Yashica

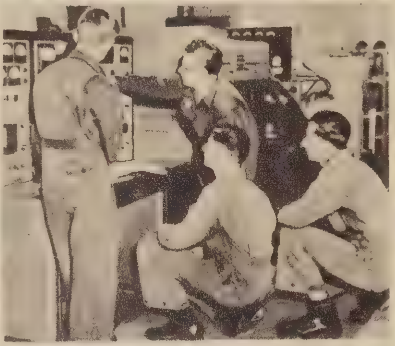
We do not sell spare parts

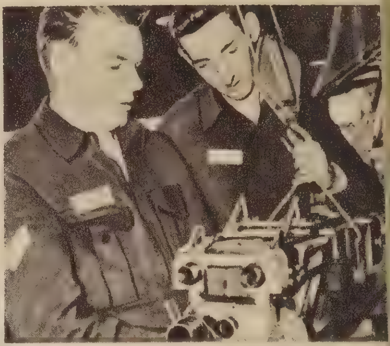
PETER G. BROUGHTON

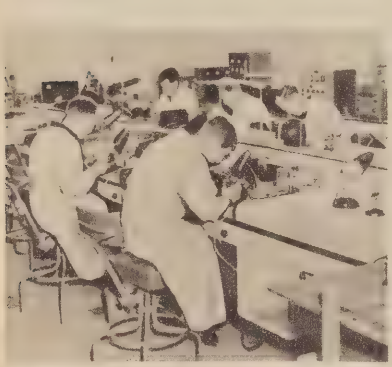
211 George Street
Sydney Tel. 27-5831

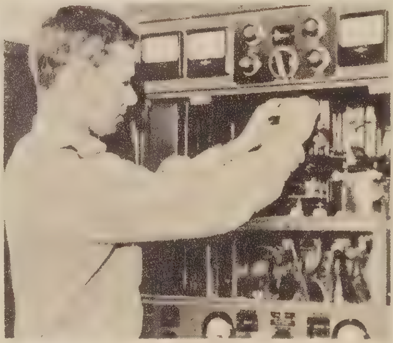
APPRENTICESHIPS IN THE RAAF

Engines. Engine Fitter pictured at work checking equipment inside a Sabre jet.


Electrical. An N.C.O. Electrical Fitter instructs Electrical Servicemen in the operation of the voltage regulator test bench.


Armament. Armament Fitters fitting a 30 mm. Aden Cannon to a mock-up of a Sabre fighter.


Instruments. Instrument Fitters reconditioning aircraft gyroscopic equipment at No. 2 Aircraft Depot, Richmond, N.S.W.


Radio. Radio Technicians (Ground) adjusting 3-Kilowatt high-frequency transmitter.

The Mirage Jet, the RAAF's most modern supersonic fighter.

RAAF sets the pace in worthwhile careers

for boys 15 & 16 years

THIS IS WHAT A RAAF APPRENTICESHIP OFFERS:

Thorough training in Radio, Instrument, Electrical and Mechanical Engineering at NO COST to parents — Full Trade Union recognition • Free medical and dental care • Free food and accommodation • All clothing and necessaries provided • Generous pay while training • Six weeks' annual leave with free return home travel.

Selected apprentices may be given Technical College Diploma or University Degree courses and appointed as commissioned officers in the Air Force Technical Branch. Australia today lives in a technical world . . . it is a sphere of life that is giving young men the opportunity to rise to great heights and responsibility. Despite this wide scope, however, competition is tremendously keen and it is the men with the better training and experience that will secure top technical positions. RAAF Apprentices receive expert training for a lifetime career in the growing field of electronics—or in the associated engineering fields of instruments, electrical, engines, airframe, mechanical transport or armament. Airmen who completed their apprenticeship only a few years ago are now qualified RAAF technicians and leaders in these fields, and later on, should they so desire, could be equally important in an appropriate civilian capacity. Ask yourself as a parent. Do you want security for your son? Do you want him to learn a specialised skill? Do you want him to have the chance to travel? Do you want him to grow up in comradeship and a happy healthy environment? All this can be his as a RAAF Apprentice. As a parent what will you advise him to do?

QUALIFICATIONS. An applicant must be a British subject, permanently residing in Australia, aged 15 but not 17 years on 1st January, 1967, and be medically fit. He must have passed, or be currently studying Fourth Form standard or its equivalent with English, Mathematics and Science.

APPLICATIONS CLOSE 15th AUGUST, 1966

clip out coupon

Staff Officer Recruiting
Headquarters Support Command, RAAF
Victoria Barracks, MELBOURNE.

Please send full details of career through the RAAF APPRENTICESHIP SCHEME.

Name..

Address..

....State......................

Director General of Recruiting, Department of Defence.

RA1·FP.56

TRADE RELEASES—IN BRIEF

AUSTRALIAN GENERAL ELECTRIC PTY. LTD. sends details on the new C106 Series of silicon controlled rectifiers, developed in U.S.A. by the General Electric Company. The makers claim these are the first plastic encapsulated SCRs in a rectangular flat-pack design for high package density printed wiring boards. Advantages claimed are: improved reliability, because of the planar passivated process used, which has all junctions protected by a silicon dioxide layer; good sensitivity, so that the devices operate directly from low-signal sensors such as thermistors, photo-conductive cells, strain gauges and similar units; rugged and compact construction.

General Electric say the C106 Series of SCRs has been designed for a variety of mount-down methods, including printed circuit, plug-in socket, screws or point-to-point soldering.

Further details are available from Australian General Electric Pty. Ltd., 103 York Street, Sydney or 552 Lonsdale Street, Melbourne.

FERGUSON TRANSFORMERS (SALES) PTY. LTD. has accepted the Australian agency for the Matsunaga International range of variable transformers and slide regulators. Availability extends from a primary of 100V with secondary of 0 to 115V at 50VA, to a fully motorised, remote-controlled, three-phase 415V primary with a secondary of 0 to 480V at 30KVA. A full range of 240V transformers is also available. Catalogues can be obtained by writing to Ferguson head office at 331 High Street, Chatswood, N.S.W. or Branch Offices in all States.

STANDARD TELEPHONES AND CABLES PTY. LTD. and its subsidiaries earned a consolidated net profit of $1,446,576 for the 12 months ending December 31st, 1965, an increase of $523,938 on the previous year's result. The profit was after provision for depreciation of $777,720 (previously $679,400) and tax provision of $730,000 (previously $348,800). It represents an earning rate of 13.7 per cent on shareholders' funds.

Export earnings for the year were the highest ever recorded by the Company. Increased activities in the fields of integrated private communication systems, specialised power equipments, and industrial products accounted for an important part of the Company's earnings.

EMERSON AND CUMING, INC., of Canton, Massachusetts, U.S.A., has developed new low loss casting resins, marketed under the name Stycast 35 series. These are intended to fill the increasing demand for encapsulants with loss tangents below 0.001. Features of the resins include high volume resistivity, high dielectric strength and low moisture absorption. Curing is effected at room temperature, after addition of accelerator and catalyst, with a post cure at 160 degrees F. for the development of ultimate properties. For many applications, the post cure is not necessary. Inquiries should be addressed to the Company's Australian agents, Wm. J. McLelland and Co. Ltd., The Crescent, Kingsgrove, N.S.W.

OLIMS CONSOLIDATED LTD. 51-61 Princes Highway, St. Peters, N.S.W. is to make in Australia a desk-top electronic calculating machine. The Company says the machine is no larger than a typewriter, and can add, subtract, multiply, divide and accumulate results up to either 14 or 20 digits. Operating time is six milliseconds for addition and subtraction, and 0.1 second for multiplication and division.

Olims will make the machine in Australia under licence from Hayakawa Electric Company, of Japan.

JFD ELECTRONICS CORPORATION, of Brooklyn, New York, has introduced a new range of rugged, miniature, variable capacitors, Series VAM. These measure about ½in long by 17-64in diameter, and are gold plated for high surface conductivity, and to prevent corrosion. A high density insulator between rotor and stator provides good structural strength.

The makers claim a Q factor of greater than 2,000, measured at 1,000MC and 10pF. Other features are: extremely low losses at higher frequencies; capacitance range from 0.8 to 10pF measured at 1MC; insulation resistance of 10 megohms at 100 VDC and 25 degrees C; working voltage of 250V and test voltage of 500V DC.

Australian agents for JFD components are the Ducon Division of the Plessey Components Group, Villawood, N.S.W.

ALLIED CAPACITORS PTY. LTD., of 752 Pittwater Road, Brookvale, N.S.W., has acquired Australian distribution rights for Silver Star capacitors, following the completion of negotiations with the U.K. manufacturers, Johnson Matthey and Co. Ltd., and their Australian associates Matthey Garret Pty. Ltd. The capacitors will be marketed by Ferris Bros. Pty. Ltd.

The Silver Star range of silvered mica capacitors is used in precision equipment throughout the world. Allied Capacitors plan to give complete coverage and service of these capacitors to the Australian electronics industry. At present there is a delivery delay of about 10 weeks.

STANDARD TELEPHONES AND CABLES PTY. LTD. has appointed Mr Gerald York as the company's West Australian representative. Mr York served in the Royal Australian Navy for 19 years and held the rank of Lieutenant-Commander when he retired in 1964. Since joining S.T.C. 15 months ago, he has held the position of Installations Manager of the Radio Transmission Division at the company's Liverpool works.

AUDIO ENGINEERS PTY. LTD. advise that in their advertisement on page 116 in the June issue of "ELECTRONICS Australia," the price of the Shure S.M.E. pick-up arm was shown as "From $37.20." This should have read "From $77.20." Audio Engineers apologise for the error and regret any inconvenience it may have caused.

(Continued on Page 150)

COAXIAL SWITCHES AND RELAYS

R. H. Cunningham Pty. Ltd. are the sole Australian Agents for products of the American Dow Key Co. Samples submitted to us for review include two coaxial relays and a coaxial switch.

The smaller version of the relays is listed under the DK77 series and is intended for use where a compact relay is required for mobile use or for other applications where small size is important.

Coil ratings of 6, 12, 24, 28, 32, 48 and 110 volts DC at less than 2.5 watts are available. A set of auxiliary contacts can be provided, with a choice of three different types of connectors. The operating time is less than 15mS. RF rating is 250 watts up to 1000MC. Dimensions including connectors, are 2-3/8 x 2-1/8 x 11/16in.

"Big brother" of the DK77 range is the DK60 series. This unit is larger and more rugged and is intended for heavier duty applications.

Coil ratings are 6, 12, 24, 28, 32, 48, 110 or 220 volts DC at 2 watts, and 6, 12, 24, 110 or 220 volts AC at 6VA, 50-60 cps. Auxiliary contacts can be provided, with two sets of change-over contacts. The RF rating is 1000 watts up to 500MC.

Operating time is quoted as being less than 30mS from application of coil voltage and less than 15mS between contacts. The dimensions including contacts, are 3-5/8 x 2½ x 1-3/16in.

In those relays where no particular precautions have been taken, the isolation at 10MC is quoted as 60 dB. However, where greater isolation than this is required (e.g. where high power is being used and the receiver front end must be given the utmost protection) then an extra device is added which gives an isolation figure of 100 dB up to 500MC.

In order to achieve this order of isolation and protection for the receiver, a common practice is to incorporate an arrangement whereby the input to the receiver is shorted at the relay during periods of transmission.

This method is not used on the Dow Key Coaxial Relay and a more refined method has been adopted: When the armature spring is operated and moves away from the contact feeding the receiver this contact, which is in the form of a plunger, follows the armature contact for a very short distance. In doing so, it disconnects from the line to the receiver and, itself, is shorted to the frame. It is claimed that the method is really necessary to minimise increase in the VSWR on the line, which is quoted as less than 1.15:1 up to 500MC, into a 50-ohm load.

The DK60 series is available with a choice of five different types of connectors.

Last but not least is the DK78 series of manually operated coaxial switches. These have a bush type of panel mounting facility, with a black engraved plate. The common connection enters at the rear centre, with the outputs arranged radially around it. The range includes single-pole two-, three- or six-way, as well as a transfer pair. A choice of five connectors the same as the DK60 relays is also available.

The uses to which such switches may be put are many. For instance, where a number of different aerials are to be selected and fed to a bank of receivers and transmitters, such switches would be ideal for the purpose.

The RF rating is 1000 watts up to 500MC. The VSWR and isolation are shown in the form of curves in the available literature. From these curves, the VSWR is less than 1.1:1 up to 500 MC and the isolation is 50dB or better at 500MC, according to the particular type.

Each of these units is solidly constructed and well finished and is backed by the usual manufacturer's guarantee.

Further information may be obtained from R. H. Cunningham Pty. Ltd., 8 Bromham Place, P.O. Box 39, Richmond, Vic., or 64 Alfred Street, Milsons Point, N.S.W (I.L.P.).

NEW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

$9.75 (£4/17/6) POST FREE

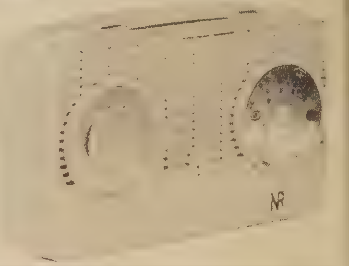
(EX LIQUIDATION STOCK H. G. PALMER)

These TV POW-R boosters can be used in two ways. Firstly as a "straight-thru" circuit giving extra boost to the TV signal for improved performance on one receiver.

Secondly to boost signal strength to two or three TV receivers coupled to the one aerial.

Full instructions supplied with each unit. 240 volt A.C. operation.

Complete KIT for TRANSISTOR 6 PORTABLE $21.95



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Dials available for all States. Post and Pack: extra. N.S.W., $1.00, Inter., $1.30.

NEW ENGLISH MAZDA TRANSISTORS

TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	55c
XA102	OC44	Osc. Transistor	75c ea.
XB103	OC75	AUDIO general purpose	75c

Ducon type SFT 123 equiv, OC74 .. .. .. 75c ea.
Available in matched pairs at .. .. $1.50 pair
AUDIO OUTPUT
Post and packing on transistors 15c any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units $5.00. Deflection yokes $5.00. Post free

NEW VALVES AT BARGAIN PRICES

1A7GT	95c	3S4	$1.00	6J5	75c	6SN7GT	95c	1L56	95c
1C7G	30c	5Y3GT	$1.25	6K7G	45c	6SS equiv. 6SK7.	85c	12A6	50c
1D8GT	95c	5V4G	$1.00	6K8G	68c	6U7G	45c	12SK7	50c
1K5G	40c	6B8	$1.00	6Q7G equiv, 6B6G	$1.00	6X5GT	75c	12SK8	50c
1K7G	49c	6C8G	50c	6SA7GT	95c	7C7	35c	12SH7	50c
1M5G	40c	6F6	$1.00	6SH7	55c	12AU7	$1.00	866	1.50
1P5G	25c	6H6	35c	6SJ7	95s	12AT7	$1.00	954	25c
1Q5G	25c							955	25c
1T4	45c							7193	25c
3Q4	75c							EK32	68c
EF50	45c							EL33	$1.00

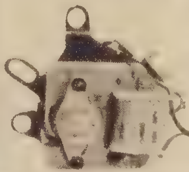
Please add postage on all valves.

NEW 4-SPEED STEREO & MONO PLAYERS
AT LESS THAN HALF PRICE

PHILIPS 4-SPEED
6V BATTERY PLAYER
MONO $9.75
STEREO $11.75

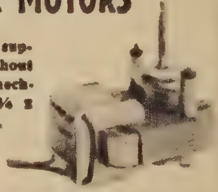
Post and Packing, N.S.W., 75c.
Post and Packing, Inter., $1.25 Extra.

NEW 240V. ELECTRIC MOTORS



3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

$2.75



NEW PORTABLE RECORD PLAYER CASES TO SUIT THE ABOVE TURNTABLE

$11.50

Attractive two-tone cabinet with plastic trim.
Supplied with 5in x 7in speaker in felt-lined enclosure
Space for amplifier and batteries or power supply.

Dimensions: 15in x 13in x 7in.
Post and Packing: N.S.W., 90c; Interstate, $1.20.

NEW MULTIMETER—$5.25

POST EXTRA
METER 0-1MA 1,000 OHMS PER VOLT
A.C. RANGES D.C. RANGES CURRENT
SUPPLIED COMPLETE WITH TEST LEAD
RANGE 0-100,000 OHMS

0—10v	0—100v	0—500v	0—500MA
0—50v	0—10v	0—1000v	
0—250v	0—50v	0—1MA	
0—500v	0—250v	0—100MA	

EXTENSION SPEAKERS

New 9 x 6 speakers in case.
Post: Interstate, 55c; N.S.W. 40c.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, $2.50. Plus Postage: N.S.W., 35c; Interstate, 52c.

Prim.: 240v, Sec. 385 x 385 at 80mA, fil. 6.3 and 5v, $2.75. Post.: N.S.W., 40c; Interstate, 75c.

60mA H.T. Chokes, 75c. Post.: 20c.

T.M.K. MULTIMETERS

Before buying see our range of T.M.K. test instruments. As advertised in April issue of Electronics Australia.

NEW MIDGET POWER TRANS.

40mA prim., 240v. Sec 225 x 225 with 6.3v. Fil. Winding.

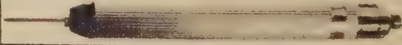
$2.75 Postage: N.S.W.., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

$2.75 Postage: N.S.W., 25c. Interstate 35c.

TRANSISTORISED SIGNAL INJECTOR, $5.50

A MUST FOR QUICK TROUBLE SHOOTING
Using TWO Transistors, complete with instruction sheet and battery. Post free.



NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer same at less than 25 per cent of list price.

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, $9.00 per 100. **Our price, $2.00 per 100.** Post and packing 25c extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, $11 per 100. **Our price, $2.06 per 100.** Post and packing, 35c extra.

The potentiometers are all current types and include switch pots, dual concentric and T.A.B. pots. List price, $12 per dozen. **Our price, $2.50 per dozen.** Post and packing, 25c extra.

FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G, 6X5GT or 1T4 as advertised on this page.

Imported National Transistorised Shoulder Megaphone

These shoulder megaphones manufactured by National Radio Japan have an output of 4 watts, and are supplied complete with inbuilt horn type speaker, batteries and microphone. List price $78.

Special Price $50. Post extra.

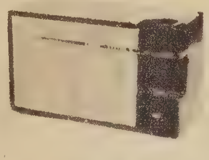
Other types also available.

NEW AMERICAN TWIN TELESCOPE TV AERIAL

Extends to 36in each section can be used singly for car or portable **$1.50**

Post 20c.

NEW 4" EXTENSION SPEAKERS



These 4" speakers are mounted in polished cabinets suitable for use as intercom. units or extension speakers.

LIST PRICE .. .. $12.

SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $4. Post and packing, N.S.W., 68c. Interstate, 98c.

NEW GARRARD RECORD CHANGERS

These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling some at LESS THAN HALF PRICE. Available in STEREO at $25.50. POST AND PACKING EXTRA, N.S.W., $1.50; QLD., VIC., TAS., $2.25; W.A., S.A., $1.30.

USED HIGH-SPEED 240V. AC/DC MOTORS

These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle $3.75
Post, N.S.W., 50c; Interstate, 85c.

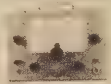
NEW 4-SPEED STEREO PLAYER F.O.R. .. $17.50 (£8/15/)

NEW STEREO CHANGER. 4-SPEED F.O.R. .. $21.50 (£10/15/)

SLIDER-SWITCHES
10 pole 2-way silver plated contacts 38c

TYGAN AND SARLON SPEAKER GRILLE FABRIC

54in wide. List price $6 per yard. To clear at $4 per yard.
Postage and packing, N.S.W., 35c; Interstate 45c.



LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Mess
Provision for crystal.
Post N.S.W., 75c; Interstate, $1.25. **$29.50**

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp., $3.75. Post, N.S.W., 20c; Interstate, 20c. Transformer for above rectifier tapped for 6 to 12 volt, with circuit for charger, $4.75. Post, N.S.W., 75c; interstate $1.00. As above, 6 or 12 volt, at 2a mp., $2.75 Post, N.S.W., 35c; interstate, 45c. Transformer for above, $3.75. Post, N.S.W., 35c; Interstate, 45c.

NEW 240V. A.C. MOTORS

These small motors, size 5in x 3in x 3½in, are 1-12 h.p., but are only suitable for intermittent use. $2.95. Post N.S.W. 35c; Interstate 50c.

THE NEW COLLARO 3-SPEED TAPE-DECKS 2 & 4 TRACK

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

- **3-speed 1⅞, 3¾, 7½.**
- **Pause control.**
- **Takes 7in. spools.**
- **Simplified controls, 4 Track, $48; 2 Track, $44. OSC Coils, $1.50**

NEW B.S.R. TAPE DECKS

These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools.
2 Track, $35.50. 4 Track 45.25.

NEW "TECH" V.T.V.M. MODEL TE65

23 RANGES. 240V. A.C. powered.

D.C.V. 1.5, 15, 50, 150, 500, 1,500
A.C.V. 1.5, 15, 50, 150, 500, 1,500.
D.B. −10db to +60db.
Resistance. 1 ohm to 1,000 megohm.

$42.50 **POST $1.00**

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SUITABLE FOR USE WITH THE COLLARO OR B.S.R. TAPE DECKS

Using 3 silicon transistors as featured in October. Electronics Australia complete with kit of parts including transistors mono **$7.50**, stereo **$13.00**, 240 power supply for above **$7.00.**

NEW 17 & 25 WATT P.A. AMPLIFIERS

25 WATT .. $53.75, £26/17/6
17 WATT .. $43.75, £21/17/6
Post Extra on 15 Watt N.S.W., 10/; Interstate, 15/.
25 Watt by Rail or Air. Too Heavy, for Post.

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms.

The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/extra.

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) .. .. $6.75 .. 67/6

Crystal Microphones for amplifier .. .. $4.75 .. 47/6

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AMATEUR BAND NEWS AND NOTES

First Y.R.S. Senior Radio Certificate

The first Senior Radio Certificate issued by the Wireless Institute of Australia — Youth Radio Scheme — has been awarded to a Sydney student.

By Pierce Healy, VK2APQ*

At the Kingsgrove High School, on hursday May 5th, Mr T. J. Molloy, Di- ctor of Administration of the Overseas elecommunications Commission (Austra- a), presented a Senior Radio Certificate ad a book prize donated by the Commis- on to Gregory Dunne, a fifth form student ad a member of the school's Youth Radio lub.

About 150 persons comprising senior udents and teaching staff attended the im- ressive function. On the dais were; Mr R. ocking, Headmaster and Chairman; Mr . Baty, Training Officer, O.T.C., Mr A. J. Vhite, Field Training Officer, O.T.C., Mr Daintry, Publicity Staff, O.T.C.; Mr R. lack, Federal Co-ordinator, Y.R.S.; Mr eedy, Deputy Principle, Kingsgrove High chool; Mrs Dunne; school captains Neil ould and Vivienne Powers.

The aims and objects of the Youth adio Scheme were related by Mr Black. e also commented on the progress that as been made during a relatively short eriod, and expressed appreciation of the nterest many commercial undertakings were howing in the scheme and the worthwhile lonations of components and tools as well s technical data that had been received rom trade houses and persons interested in those aims.

Mr Molloy spoke of the development and xpansion of the electronics industry and the many careers available to those interested in this particular field. He also stressed the need for training electronics engineers and technicians in increasing numbers and, to this end, expressed appreciation of the work of the Youth Radio Scheme in providing initial training for those interested in radio and electronics.

In presenting the Certificate, Mr Molloy congratulated Gregory on being the first member of a Y.R.S. Club to gain the Senior Radio award and expressed his pleasure in presenting the book prize donated by the Commission.

To qualify for the Senior Radio Certificate, a student, in addition to obtaining satisfactory passes in all lower certificate grades, must pass two written exams each of two hours duration (five questions selected from eight in each case) and complete six constructional projects.

The theory papers set for the exam were:

SENIOR RADIO CERTIFICATE

PAPER A

Question 1: Draw a block diagram to show the various Stages in a TRF receiver. Explain the principles involved in the operation of a receiver of this type. In what respects does the operation of a TRF receiver differ from that of a superheterodyne receiver?

Question 2: Draw the circuit of a mains operated power supply which will provide 6.3 volts for the filaments and 250 volts for the high tension of a short wave receiver. Then explain how such a power supply operates.

Question 3: Define (a) amplification factor, (b) space charge, (c) grid bias, (d) inductive reactance, (e) automatic volume control, (f) pulsating DC, (g) capacitive reactance, (h) inter-electrode capacity, (i) intermediate frequency, (j) flux density.

Question 4: Using neat sketches, show how a permagnetic loudspeaker is constructed. Explain how it operates. Why is a speaker transformer used in conjuction with such a loudspeaker? In what ways is its construction different from that of an electro-dynamic loudspeaker?

Question 5: Using neat circuit diagrams, illustrate and explain three common methods of coupling audio frequency amplifier stages. Discuss the relative merits of these methods.

Question 6: Describe one laboratory experiment which you have undertaken in your science course at school, relating to some aspect of Electricity, Magnetism or Electronics. Explain clearly the aim of this experiment, sketch the apparatus involved, detail the various steps in the development of the experiment and tabulate the results and conclusions you reached.

Question 7: Select some constructional project you have completed which involved the use of transistors. Draw a neat circuit and explain the principles of operation. Indicate the values of the components used. What special precautions did you take in handling the transistors? Select some project which involved the use of at least three transistors.

Question 8: Select ONE constructional project which you completed for the Senior Radio Certificate. Draw neat circuit diagrams for the unit selected. Indicate component values. Explain the operating principles of this equipment.

PAPER B

Question 1: Using a neat sketch, describe the construction of a beam power valve. What advantages does a beam type have over an ordinary pentode?

Question 2: (a) A parallel tuned circuit having a tuning capacitor of 200 picofarads resonates at a frequency of 3.5MC. Calculate the value of the inductor (coil) in microhenries. Write the formula and show all working.
(b) Using the same coil, what would be the resonant frequency of the circuit if the tuning capacitor is changed to 50 picofarads?

Question 3: Give neat sketches and brief explanations to show how you would connect (i) a carbon microphone, (ii) a crystal microphone and (iii) a low impedance dynamic microphone into the grid circuit of the first speech amplifier of a modulator or P.A. system.

Question 4: Define (i) the "Q" of a coil, (ii) distortion, (iii) impedance matching, (iv) power amplifier, (v) second harmonic, (vi) push-pull amplifier, (vii) link coupling, (viii) frequency modulation, (ix) carrier, (x) side bands.

Question 5: An EMF of 1600 volts DC is applied to a resistance of 50 ohms connected in series with two resistors of 600 ohms and 200 ohms in parallel. Calculate (i) the current flowing through the 50 ohms resistor and (ii) the power dissipated in the 600 ohms resistor. Write the formula used in each calculation and show all working.

Question 6: (a) What losses may occur in a transformer to reduce its efficiency?
(b) You remove the 5 volt winding from a power transformer and find there are 30 turns on that winding. How many turns would you expect to find on the 200 volt secondary winding? You wish to operate a relay using a 16 volt winding. How many turns would you wind on for this purpose?

Question 7: Explain FIVE of the following: — (a) eddy currents, (b) henry, (c) self inductance, (d) hysteresis, (e) working voltage, (f) dielectric, (g) breakdown voltage, (h) resonance, (i) static, (j) skip distance.

Question 8: Select ONE constructional project which you have completed for the Senior Radio Certificate. Draw neat circuit diagram, indicting the component values. Explain the operating principles of this unit. Do not describe the unit which you have already discussed in Paper A.

***News and notes of Divisional and Club activities, submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**

WIRELESS INSTITUTE ACTIVITIES

Some concern has been expressed by all divisional councils at the number of members who omit to pay their membership fees within the period laid down in the constitution. This omission causes a large increase in the amount of work carried out on a voluntary basis by officers of the Divisions. It is pointed out that this omission deprives such members from receiving copies of the magazine "Amateur Radio" and divisional bulletins for the period which they remain unfinancial and cannot be replaced.

AUSTRALIS PROJECT

A planning committee has been formed to co-ordinate the construction and testing of the joint W.I.A. and Melbourne University Astronautical and Radio Society's, earth satellite project "Australis."

The W.I.A. members of the committee are Harold Hepburn VK3AFQ, Peter Williams VK3IZ, David Rankin VK3QV and Cyril Edmonds VK3AEE.

Two tests were made during May, using high altitude balloons carrying prototypes of units to be carried in the satellite. The first was the VHF 144MC telemetry transmitter and the second the 28MC identification beacon transmitter. Both tests were successful. The balloons carried the equipment to a height of twenty miles.

It is hoped that the completed unit will be sent to the United States for launching by the American amateur Project Oscar organisation before the end of the year.

NEW SOUTH WALES

The monthly meeting of the New South Wales Division was held at Wireless Institute Centre, 14 Atchison Street, Crows Nest on Friday evening May 27th.

The guest lecturer for the evening was John Featherston, W5RPL, a Master of Engineering, who has carried out extensive research into radio communication. The lecture, "New Thoughts on Radio Communication," dealt with high frequency telegraphy.

This informative and well presented lecture traced the history of radio communications and gave an insight into the recent research into the use of CW and FSK high-speed telegraphy in high frequency channels.

It was pointed out that this was a fascinating field which offered extensive scope for technical research, in which amateurs could take part, and this enhanced the claims made for the retention of amateur frequency allocations. In this regard, it was considered that while building in size was confined to large commercial organisations, there was nothing to limit the amateur in depth of thinking.

To illustrate the lecture there were several pieces of equipment in operation and an excellect selection of colour slides was shown. Many of the slides showed the installation at the lecturer's laboratory station at Tucson, Arizona, and various antenna installations in use there.

Later a book prize donated by Overseas Telecommunications Commission (Australia) was presented to Ern Chalker, by Mr Thatcher an officer of the OTC

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SOLID STATE EQUIPPED
TRANSMITTER-RECEIVERS
TRANSCEIVERS

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Mobile-base Operation	Portable Operation
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Receiver Sensitivity: luv 20db S/N	luv 15db S/N
Selectivity: 2.5K/C 6db	2.5K/C 6db
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Temp. Range: −10°C+70°C 95% RH	−10°C+70°C 95% RH
Weight: 15lbs.	7lbs.

Vacuum and Dustproof Plug-in Relay Equipped

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HENDON. SOUTH AUSTRALIA

training staff. Ern is the first member of YRS postal group to gain an amateu licence.

In making the presentation, Mr Thatche paid tribute to the advantages the schem offers to those wishing to make a career i the electronics field, and reiterated some o the difficulties that a training officer meet when interviewing an applicant for position.

Mr Thatcher also presented a solderin iron, donated by Mr Royston of the Adcol company, to Gregory Dunne, for hi achievement in gaining the Y.R.S. Senio Radio Certificate.

Two vacancies have occurred on the New South Wales Division Council, a both Maurie Marsden VK2VV and Kevin Collins VK2ANY have resigned due to business commitments. Stan Dogger, VK2ZRD, has been co-opted to fill one of these positions.

VHF and TV GROUP

The May meeting of the VHF and TV Group had the largest attendance yet recorded, more than 100 members being present. The lecture was given by Les Jenkins VK2ZBJ, on the use and applications of Fairchild transistors. Les specifically mentioned the 2N3564 and presented basic circuits for 12 different receiver and transmitter applications.

The Group meets on the first Friday in each month at the Wireless Institute Centre, 14 Atchison Street, Crows Nest, commencing at 8 p.m. Visitors are always welcome.

HUNTER BRANCH

The May meeting of the Hunter Branch was held at the Technical College, Tighes Hill, and featured two outstanding lectures on topics of interest to amateurs.

Frank Boundy, VK2ZFX, gave a comprehensive talk on the construction and use of relays and their application in amateur radio equipment. Each member attending was provided with detailed notes and drawings of the points discussed in the lecture.

The second lecture was delivered by Barrie Unsworth, VK2ZUB, who spoke at length about a transistor modulator he had designed to be used in a mobile transmitter. All details of the unit were presented in circuit diagram form and winding information for all the transformers was made available for prospective builders.

The Hunter Branch committee has arranged an interesting series of lectures for monthly meetings to be held on the first Friday of each month until December. Visitors are always welcome at meetings which are held in Room 6, of the Clegg Building, Newcastle Technical College, Tighes Hill.

Several mobile stations are now operating along the central coast between Gosford and Newcastle using the 146MC net frequencies. Contacts have been reported between Toronto and Kulnura. Good coverage of the Newcastle area has been made from the proposed base transmitting site, eleven miles from the Newcastle Post Office, on a hill west of Teralba. In addition, members of the WICEN net report very satisfactory mobile-to-mobile contacts in both Newcastle and Gosford areas.

The Hunter Branch Field Day will be held during the holiday weekend in October. Arrangements are well in hand for a full program of transmitter hunts, a scramble and other competitions. Further details of this very popular event will be given in these notes next month.

CENTRAL COAST BRANCH

At the May meeting of the Central Coast Branch, held on Friday, May 20, in the School of Arts, Gosford, 17 members attended, despite the fact that it was a very wet and cold evening. The guest speakers for the evening were Keith Howard, VK2AKX, and Tony Mullen, VK2ZCT, both members of the Hunter Branch.

Keith, who was official observer for the New South Wales Division at the recent ederal Convention of the Wireless Institute f Australia, held in Brisbane, gave a talk n the proceedings at the convention and delights of his trip. The reasons for the ecisions made on various agenda items ere explained, in particular the points concerning the proposed new Federal Constitu- on and the necessity for the changes ecommended.

The talk on transistor converters by Tony ullen, VK2ZCT, was most interesting and nstructive and brought members up-to-date ith some of the modern techniques associated with transistorised equipment.

Plans are afoot to provide, at a nominal um, kit sets for 144MC converters to members interested in operating on that band. hose interested are advised to contact ither Frank Jarvis, VK2AFJ, or Lindsay ouglas, VK2ON, for details.

The most recent member of the Branch o receive a call sign is Peter Kerr, who can e heard on 144MC signing VK2ZPK.

The Branch meets on the third Friday of ach month in the School of Arts, Gosford, ommencing at 8 p.m. Visitors are always elcome.

MURWILLUMBAH RADIO CLUB

The Murwillumbah Amateur Radio Club n the far North Coast of New South Wales as been in operation for the past 10 nonths. The Club meets every second Wednesday in the month at 7.45 p.m., in the cience Block of the Murwillumbah High School.

In addition to ten senior members and a umber of High School pupils the licensed mateur operators are:

E. Bailey, VK2BB; C. Goldstone, VK2APS; W. Campbell, VK2ZY; N. Carpenter, VK2RK; and I. Dunlop, VK2AVS.

The office-bearers are:

President: E. Bailey, VK2BB.
Vice-President: C. Goldstone, VK2APS.
Secretary: M. Harley, Assoc.

Travellers passing through or holiday makers to the area can obtain details of activities by phoning the secretary, during working hours, at Murwillumbah 108. Visitors will always be welcomed.

VICTORIA:

The office-bearers of the Victorian Division, elected for the forthcoming year are:

President, Ken Pincott, VK3AFJ.

Vice-Presidents: Michael Owen, VK3ZEO; Tom Cuthbertson, VK3ZIQ.

Secretary: Ken Seddon, VK3ACS.

Treasurer, William Faul, VK3AGZ.

Librarian, Bill Roper, VK3ARZ.

Instrument Library, Cyril Maud, VK3ZCK.

QSL (inward), Eric Trebilcock, Associate; (outward), Ivor Stafford, VK3XB.

AOCP class Instructors, Theory, Cliff Pickering, VK3ATP; Morse Code, Jay Lancaster, VK3JL; Correspondence, Ken Seddon, VK3ACS.

Disposals Committee: John Battrick, VK3OR; John Spicer, VK3ZER; Tom Cuthbertson, VK3ZIQ; Leo Fowler, VK3ZGF; Jack Kelleher, VK3AIJ; Jim Stewart, VK3ZFS.

Broadcast Committee: John Wilson, VK3ZOQ; Peter Downie, VK3APD; Len Poynter, VK3ZGP; Ron Fisher, VK3OM; Cyril Edmonds, VK3AEE; Bill Roper, VK3ARZ.

WICEN Co-ordinators: John Patrick, VK3OR; Michael Owen, VK3ZEO. State Controller, Harold Hepburn, VK3AFQ. Technical Co-ordinator, John Spicer, VK3ZEL.

TVI Committee: Jack Taylor, VK3ZJF; Bill Rice, VK3ABP; George Fathing, VK3AFR.

Youth Radio Scheme Liaison Officer; John Battrick, VK3OR.

Publicity Officer: John Wilson, VK3ZOQ.

Membership Drive Project Officer, John Beckett, VK3ZCB.

Editor, "Amateur Radio:" Ken Pincott, VK3AFJ; Assistant Editor, Kel Cocking, VK3ZFQ.

During discussions following the appointment of officers, it was agreed that assistant office bearers should be appointed, to ensure continuity of administration policies. An invitation to contact the Secretary is extended to members wishing to assist in this matter.

VK3UJ—PORTABLE/MOBILE

Andy Roudle, VK3UJ, of Croydon, Victoria, will commence a tour of all VK mainland call areas except VK6 during July and August and will be operating on Single Sideband in the 80; 40; and 20 metre bands.

The proposed itinerary is: Melbourne to Port Augusta, July 2, 3, 4. Alice Springs to Ayres Rock, July 6 to 14 inclusive. Alice Springs to Darwin, July 15 to 20 inclusive; Darwin to Townsville and Cairns July 21 to August 16; Cairns to Melbourne, August 6 to August 31.

Regular times of operation have not been set down, but will probably be around 8 a.m., 1 p.m. and during the evenings. The main operating frequencies will be approximate 3.675MC, 7.075MC, 14.125MC and 14.210MC.

All contacts made will be acknowledged by a special QSL card, also cards will be sent to short-wave listeners who send in reports and request a card. So keep a listen out for VK3UJ with an appropriate suffix, travelling through central and eastern Australia during July and August.

SOUTH AUSTRALIA

As a service to Institute members visiting other States and interstate members visiting Adelaide, the South Australian Division of the W.I.A. has inaugurated what should be a very popular scheme. Members of the South Australian Division travelling interstate by car will be able to borrow from the Institute, in Adelaide, mobile units for operation on the 53.032MC and 146MC net frequencies.

Institute members from other Divisions visiting Adelaide with six metre AM mobile equipment will be able to borrow from the South Australian Division crystals for operating on the 53.1MC net frequency.

Those wishing to avail themselves of this service should contact the Secretary, South Australian Division, W.I.A., Box 1234K, G.P.O. Adelaide.

QUEENSLAND

The Annual Report of the Queensland Division by the President, Lawrie Blagbrough, VK4ZGL published in the Division's Bulletin "QTC," gave a very comprehensive coverage of activities during the past year.

Special mention was made of the Federal Convention of the W.I.A. held at Easter, the first held in Queensland since 1936. One of the schemes recently inaugurated was the compiling of data on the number and type of stations illegally using the amateur segments of the HF bands.

Mention was also made of the progress made toward amending the Division's Constitution, to enable incorporation, in a similar manner to other divisions. Several members attended the Civil Defence signals course at Mount Macedon, Victoria, and are now participating in the work of the WICEN organisation.

The activities of the QSL officers increased and 10,139 cards were dispatched on behalf of members, 1,579 more than in 1965.

About 95 per cent of members have met the levy imposed for the W.I.A. ITU Fund. Other financial aspects were in a sound condition.

The report concluded with a resume of the tasks carried out by various officers and an expression of thanks for the assistance given.

WESTERN AUSTRALIA

The annual report, presented by V. J. Kitney, VK6GH, president of the West Australian Division, recorded a growth in membership during the year, also increased attendance at monthly meetings. It also made mention of progress being made in the division's WICEN organisation.

The secretary's report referred to the apparent success of a membership drive

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Freq. 120KC-500MC (7 Bands)
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AF Output. 8v400cps.
Mains operated. 240v.
Xtal Socket.
Complete. Test leads inst. book.
$27.25

Freq. 120KC-260MC (6 Bands)
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AF Output. 8v400cps.
Mains operated. 240v.
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$26.50

TE-20

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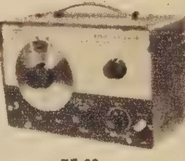
Freq. 20cps-200KC. (4 Bands)
Output. Sine 7v, Square 7v P-P.
Distortion. Less than 2 p.c.
Output Impedance. 1000 ohm.



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Freq. Response 60cps-150KC ± 1.5 DB.
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TE-22D

Same as TE-22 only has 4 step attenuation.

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Capacity. 20uuf-2000uf (4 Range).
Resistance. 2ohm-200Mohm (4 Ranges)
Tests. Power factor, leakage, impedance, transformer ratio and insulation resistance to 200Mohm at 600v.
Mains operated. 240v.
Complete. Test leads, etc.
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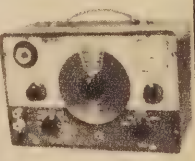

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WESTERN AUSTRALIA

We wish to advise that all correspondence and orders in Western Australia should be forwarded to P.O. Box 3, Inglewood, W.A. as we have appointed an agent in this area who has stocks of all items advertised by us.

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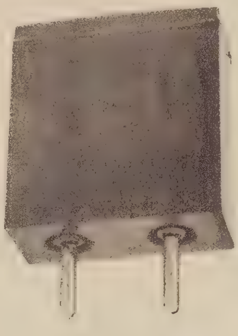

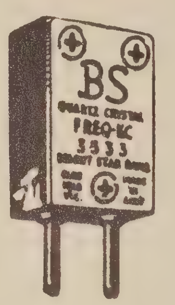

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TOLERANCES: .0015% .002% .003% .005% ETC.

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made during the year, but stressed that this activity must not be allowed to lapse.

The procurement and dispatch of overseas technical publications had proved a very popular venture as was evidenced by the volume of business transacted.

TASMANIA

A slow Morse practice session is held each Tuesday, Thursday and Sunday evenings at 8 pm on 53.35MC for the benefit of limited licence holders wishing to improve their speed in order to gain a full licence. Checks are taken throughout the session from participating stations. This service could also serve as a beacon transmitter for interstate operators wishing to check band openings.

Members of the Tasmanian Division Council for the ensuing year are:—

President: T. Allen, VK7AL.

Secretary: C. Russel Green, VK7CR.

Treasurer: T. Conner, VK7CT.

Members: E. Cruise, VK7EJ; G. D'Emden, VK7ZAS; J. Grace, VK7ZJG; I. Nichols, VK7ZZ.

NEWS OF I.T.U.

The twenty-first session of the Administrative Council of the International Telecommunication Union commenced on May 9 and continued until June 4.

At its meeting in Montreux last September, the ITU Plenipotentiary Conference decided to increase council membership from 25 to 29, because of the growth in the number of member countries in the union and of the need for a more equitable geographical distribution.

The 29 members of the Administrative Council elected by the Plenipotentiary Conference are as follows:

Region A (America): Argentine Republic, United States of America, Canada, Mexico, Venezuela, Brazil.

Region B (West Europe): France, Italy, Swiss Confederation, Federal Republic of Germany, United Kingdom of Great Britain and Northern Ireland, Ireland.

Region C (East Europe and North Asia): Union of Soviet Socialist Republics, Federal Socialist Republic of Yugoslavia, Peoples' Republic of Poland.

Region D (Africa): Kingdom of Morocco, Republic of Dahomey, Federal Republic of Nigeria, Algerian Democratic and Popular Republic, Ethiopia, Malagasy Republic, Uganda.

Region E (Asia and Australia): Japan, Commonwealth of Australia, Republic of India, Pakistan, Lebanon, Kingdom of Saudi Arabia, China.

In November, 1965, the new Administrative Council held a plenary meeting at Montreux, during which Mr Rudolf Rutschi (Switzerland) was elected chairman, and Mr Proinnsias L. O'Colmain (Ireland) vice-chairman for the twenty-first session.

As usual, in addition to a number of administrative matters regarding the finance and personnel of the union, in particular the budgets for the years 1966 and 1967, the council has on its agenda a number of items on the technical activities of the organisation such as:

—the annual report for 1965.

—the preparation of a number of conferences and meetings.

—the various aspects of technical co-operation programs.

—progress in space communications.

There is no doubt that the proceedings of this session will be closely followed by Amateur Service bodies throughout the world, who are becoming more aware of the effect that increasing demands by commercial interests are likely to have on the Amateur Service frequency allocations.

The Aeronautical Radio Conference, convened in Geneva by the ITU, concluded its work on Friday evening, April 29, when the final acts were signed, this was one week before the date fixed for the end of the second session which had begun on March 14.

The purpose of the conference was to draw up a new world plan for high fre-

---

JOHN MOYLE MEMORIAL—RESULTS

The results of the 1966 John Moyle Memorial National Field Day show that approximately the same number of stations participated as in previous years.

Anticipating that the increasing use of single sideband would mean that more stations using transceiver equipment would participate, the Contest Committee decide to lift the power restriction and included provisions in the rules for awards to be made for both high and low-power sections.

Unfortunately this increased activity did not eventuate and the comment has been made, that non-participation was a sad reflection on the interest of SSB operators in the contest, when taking into account the money they had invested in buying portable transceivers.

However most comments received praised the rules set down for the 1966 contest, and consideration will be given to a slight modification for 1967, to allow cross-band operation.

As this contest is for field operation, the Committee will also try various inducements to entice stations out into the field, and would welcome any suggestions that might assist in achieving this aim. Comments from VK2JM, VK2YB, VK2SS and VK3HE, who participated as single operators, indicated that the introduction of the six-hour period was an excellent decision.

The operators of VK3AWI had some anxious moments when some nocturnal visitors in the form of a dairy herd decided to inspect the generating plant, while VK3RN and VK3APC club members learnt that a mixture of water and petrol is not a good brew for petrol driven generators.

VK5WC expressed disappointment at the lack of fixed stations taking part in the contest. Access to his site from Woomera was over eight miles of bumpy, rock strewn track.

Some of the equipment used was: Type 3; 522; Home made; Swan 240; FL100B; ATR2C; No. 19; KWM2; Galaxy 5; Drake; NCX5; No. 122: Command; H.R.O.; BC348; AMR300; Geloso: Eddystone. Aerials mostly favoured were; Ground planes on VHF, with "V" and long wires favoured for the HF bands.

Although the six-hour period was intended to be a continuous period, no penalty was imposed for other forms of time periods. It is likely that next year's rules will allow any number of periods of operation totalling six hours.

RESULTS

Call sign	Sect-ion	6 or 24 hrs.	No. Ops.	Pwr.	Cont-acts	Pts.	Certificates for
VK2SS-P	A	6	1	9W	23	173	Low power operating points
VK40F-P	A	6	1	10W	6	39	
VK5SS-P	A	6	1	11W	17	155	Low Power.
VK6ZAG-P	A	6	1	10W	5	10	
VK7JF-P	A	6	1	20W	32	301	1st in 6 hr. transmit. Phone
VK2YB-P	B	6	1	11W	26	159	Low Power.
VK2JM-P	B	6	1	11W	22	171	1st in 6 hr. transmitting CW
VK3HE-P	C	6	1	26W	26	152	1st, 6 hour transmitting Open
VK4UC-P	C	6	1	16W	24	151	Low Power.
VK3YS-P	D	6	3	3-240W	96	539	1st, 6 hour multi-operator
VK3QZ-P	D	6	4	6-15W	38	206	Low Power
VK3RJ	E	6	1	25W	19	240	1st, 6 hour Fixed Station
VK5FJ	E	6	1	100W	9	125	Low Power
VK5WC-P	A	24	1	25W	49	413	1st, 24 hr. transmit. Phone
VK6MM-P	A	24	1	7W	12	76	Low Power
XK7JO-P	A	24	1	6W	15	118	Low Power
VK2AGI-P	B	24	1	7W	57	403	1st, 24 hr. transmitting CW
VK5ZF-P	B	24	1	15W	33	265	Low Power
VK5ZF-P	C	24	1	15W	52	352	1st, 24 hour Open
VK1ACA-P	D	24	6	100W	152	1206	
VK2AAH-P	D	24	8	150W	730	3969	1st, 24 hour Multi-operator
VK2GN-P	D	24	10	150W	196	1218	
VK2ATZ-P	D	24	3	20W	61	479	Low Power
VK3RN-P	D	24	14	150W	414	2649	
VK3AWI-P	D	24	10	150W	396	2170	
VK3AHZ-P	D	24	5	150W	267	1516	
VK3AAW-P	D	24	5	12W	42	286	
VK4CS-P	D	24	4	150W	112	805	
VK9XI-P	D	24	5	100W	96	583	
VK2AEC	E	24	1	100W	16	225	
VK2ZO	E	24	1	100W	5	65	
VK3XB	E	24	1	150W	71	905	Merit for working number of Field Station
VK3ANG	E	24	1	20-50W	34	390	
VK3EF	E	24	1		28	340	
VK5NM	E	24	1	30W	9	125	
VK6KH	E	24	1		5	75	
VK7SM	E	24	1		65	950	1st, 24 hour fixed station

Receiving Section

L2033	D. W. Shepherd	200 Points	1st in Call Area
L3229	R. J. Halligan	995 Points	1st in Call Area
L3042	E. Trebilcock	759 Points	
(VK4)	K. Cunningham	315 Points	1st in Call Area
(VK5)	J. Ross	880 Points	1st in Call Area
L5015	W. J. Clayson	465 Points	
L5065	A. Raftery	310 Points	
L6028	B. J. Proser	42 Points	1st in Call Area
L7031	R. J. Mutton	905 Points	1st in Call Area

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PRICE £9/15/ ($19.50)
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POWER SUPPLY for Z-12: 6, 9, 12, 15 volts at 1 amp,
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SPECIFICATIONS:
No. of transistors: 8.
Overall size: 3in. x 1.8in. x 1.3in.
Weight: 3oz.
Output power into 3 ohm load:
  5 watts RMS continuous with 12-volt supply.
  8 watts RMS continuous with 15-volt supply.
  13 watts RMS continuous with 18-volt supply.
Output power into 1.5 ohm load:
  10 watts RMS continuous with 12-volt supply.
  16 watts music power with 15V. supply.
Power response: 1.5dB below 1KC at 20KC and 65 cps.
Frequency response: 15 c/s to 50KC plus or minus 1dB.
Input sensitivity: 2mV into 2Kohm.
Quiescent consumption: 12-volt supply—15mA.
Signal to noise ratio: Better than 60mA.
Total distortion: Less than one per cent.

SWR METERS Model KSW-10

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STANDING WAVE RATIO
FORWARD

SPECIFICATIONS:
Standing Wave Ratio: 1:1 to 1:10.
Accuracies: Plus or minus 3% scale length.
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As-new condition.

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AC126	9/6	95c	OC170/AF115N	10/	$1.00
AC127	10/6	$1.05	OC171/AF114N	10/	$1.00
AC128	10/	$1.00	2N217	9/6	95c
AF114N/OC171	10/	$1.00	2N270	13/6	$1.35
AF115N/OC170	10/	$1.00	2N370	19/	$1.90
AF116N	9/6	95c	2N372	19/	$1.90
AF117N	9/6	95c	BY100/OA214	16/	$1.60
AF118	22/	$2.20	OA79	4/	40c
BC107	11/	$1.10	OA80	3/	30c
BC108	10/	$1.00	OA81	3/	30c
BC109	14/	$1.40	OA90	3/3	32c
OC26	26/	$2.60	OA91	3/3	32c
OC35/AT1138A	35/	$3.50	OA95	3/3	32c
OC44N	11/	$1.10	OA200	7/6	75c
OC45N	11/	$1.10	OA210, 1N1763, 1N3194, HR25	8/6	85c
OC70	12/	$1.20	OA211, S10AR2	16/	$1.60
OC71/2N215	7/6 (or 3 for £1)	75c (or 3 for $2)	1N3491 40 piv 18 amp	9/6	95c
OC72	13/6	$1.35			
OC74N	9/6	95c			
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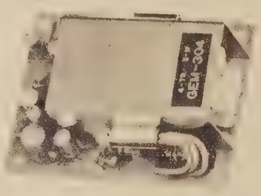
OAZ212	12/6	$1.25	OAZ224/BZZ16	27/6	$2.75
OAZ213	12/6	$1.25			



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Circuit: 4 Transistor Push Pull. Output Power: 2 Watt, 10 p.c. U.D. 3 Watts Maximum. Gain: 10 mv for 2 watt output at 1 Kc. Output Impedance: 8 ohms and 16 ohms. Frequency Response: 150—10,000 c/s. Current Consumption: 12 mA at no Signal. 500 mA for maximum power.
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550 Kc—1600 K/c A.M. Circuit: 3 Transistor, one diode. Tuner Assembly, excluding audio amplifier, driver and output circuitry and etched printed circuit board. Containing a variable condenser, oscillator, converter, I.F.'s, detector, and associated components.
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Ratio 8 to 1, reduction, scaled 0-10.

Type T501, 1½in diam.	$1.75	(17/6)
Type T502, 2in diam.	$2.20	(22/)
Type T503, 3in diam.	$2.80	(28/)

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1A5	50c	6SF5	75c
1A7GT	$2.60	6SF7	75c
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1D4	75c	6SJ7	$1.25
1D8	75c	6SK7GT	$2.00
1F5	$1.00	6SL7GT	$1.25
1H5	75c	6SN7GT	$1.00
1K5	50c	6SQ7GT	$2.60
1K7	50c	6SS7	75c
1L4	50c	6U5	$1.85
1L5	$1.00	6U7	75c
1LN5	50c	6U8	$1.70
1M4	50c	6V4	$1.14
1M5	50c	6V6GT	$1.75
1P5	50c	6X4	$1.00
1Q5	50c	6X5	$1.45
1R5	$1.90	7A8	40c
1S2	$1.75	7C5	50c
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2A5	75c	7W7	50c
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2E26	$2.50	12AT7	75c
2X2	50c	12AU7	$1.50
3A4	$2.20	12AU7A	$1.50
3A5	$1.00	12AV6	75c
3Q5	$1.00	12BE6	75c
3S4	$1.00	12C8	50c
3V4	$1.50	12J5	50c
5AR4	$2.60	12SA7GT	$1.00
5AS4	$1.45	12SC7	50c
5RG4GY	$3.75	12SG7	75c
5T4	$1.75	12SK7	50c
5U4GB	$1.45	12SN7	75c
5V4G	$1.75	12SQ7	50c
5Y3	$1.38	12SR7	50c
5Y4	75c	16A5	$1.70
5Z3	$1.75	16A8	$2.10
6A3	75c	25L6	$1.00
6A6	75c	25Z6	$1.00
6AB7	$1.00	35L6GT	$1.00
		19	50c
6AC7	75c	30	50c
6AG5	50c	47	50c
6AG7	$1.25	57	50c
6AJ5	75c	58	50c
6AK5	$1.50	80	$1.70
6AL5	$1.40	717A	75c
6AM5	$1.50	807	$3.75
6AM6	$1.00	808	$1.00
6AN7A	$1.65	809	$2.00
6AR7GT	$2.10	830B	$1.50
6AS7GT	$2.00	832A	$6.00
6AU6	$1.45	866	$2.50
6AU8A	$2.40	954	50c
6AV6	$1.40	955	50c
6B6	75c	956	50c
6BA6	$1.55	958A	50c
6BE6	$1.55	1616	$1.50
6BL8	$1.80	1625	50c
6BM8	$1.85	1626	50c
6BQ5	$1.70	1629	50c
6BR5	$1.45	5636	75c
6BX6	$1.45	5763	$2.80
6BY7	$1.45	5819 Vidicon	$10.00
6BZ6	$1.60	6021	$1.00
6C6	50c	9004	50c
6C8	$1.00	EA50	40c
6CG7	$1.55	ECC35	$2.00
6CH6	$2.35	ECH33	$2.00
6CM5	$2.25	ECH35	75c
6CW4	$3.00	EF86	$1.85
6F8	50c	EY91	50c
6G6	75c	KT66	$3.00
6G8G	$2.60	QQEO3/12	$4.75
6H6 Metal	50c	QVEO4/7	$2.50
6J5GT	$1.00	RL18	75c
6J6	$1.00	UL41	$1.00
6K6	$1.00	VR102	50c
6K7	50c	VR135	50c
6K8GT	$1.25	VR136	50c
6K8 Metal	$2.00	VR137	50c
6L7	50c	VR150	$1.25
6N7	50c	VT78 (6D6)	50c
6R7	75c	VT127	50c
6S5	75c	VT501	75c
6SA7	75c	VU39A	50c

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Model PT34

300 uA movement.
AC and DC voltages:
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Current ranges (mA)
0-1, 0-100, 0-500 mA.
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Size 3¾ x 2½ x 1¼ inches.

Price 57/6. $5.75
Complete with leads.

uency radio communication for the use f aircraft flying on regional, national nd international civil air routes. The first ession had taken place from January 27 February 20, 1964, when it determined e technical and operating principles which ere to serve as a basis for preparation of e plan. In the period between the two essions, the telecommunication administra-ons of the member countries of the TU have submitted statistical data on air-raft operation for analysis.

Under the direction of the chairman of e conference, Dr Arthur L. Lebel, head f the United States delegation, who was ssisted by two vice-chairmen (Mr Alexander arov, head of the U.S.S.R. delegation and Ir R. Monnat, Head of the Swiss delega-on), about 160 delegates from more than 0 member countries of the ITU prepared plan to replace the one which had been rawn up in 1949. The new plan will ome into force on July 1, 1967. It will be rought into force progressively and its pplication will be completed on April 1, 970.

Radio channels have been redistributed o meet the new conditions posed by civil viation. In addition, the plan provides ules for the use of new transmitting echniques (for example Single Side Band mission) while the boundaries of the areas o which the frequencies are allotted have een brought up to date. Despite the con-iderable increase in aeronautical traffic ince 1949, it has proved possible — hanks to technical progress and the judi-ious allocation of frequencies — to remain vithin the limits of the same bands as for he 1949 plan.

The conference adopted a certain number of recommendations and resolutions, one of hem concerning the protection against harmful interference of the high frequency band allocated exclusively to the Aero-nautical Mobile Service. Two resolutions relate to the use, as far as practicable, of VHF for aeronautical service and the broadcasting of meteorological information for aircraft in flight. Another resolution relates to the gradual replacement by administrations, as soon as possible, of double sideband by single sideband tech-nique.

Finally, the conference, taking note of the possibilities offered by space radio communications, recommends that admini-strations, while taking into account the relevant economic and operating factors, should consider the possibility of meet-ing the requirements of the aeronautical mobile service on the main world air routes by means of space communication tech-niques.

OTHER ITEMS

YO CONTEST

The following details have been received for the YO-Rumania—CW Contest.

1. Date: First weekend of August each year.
2. Time: 1800GMT Saturday, 2400GMT Sunday.
3. Bands and mode: 3.5, 7, 14, 21, 28MC, CW only.
4. Contest Call: TEST YO.
5. Type of competition:
   (a) Single-operator, single-band.
   (b) Single-operator, multi-band.
   (c) Multi-operator, single-band.
   (d) Multi-operator, multi-band.
6. Object: All stations will try to contact as many YO stations in as many YO land regions as possible, on all available bands.
7. Exchange: RST plus QSO number, starting with 001 regardless of band.
8. Scoring: Each contact is TWO points. Uncomplete or untrue sending or logging of a call sign or a control number is ONE point.
9. Multiplier: The call sign of the YO stations will be followed by two letters

(Continued next page)

W.I.A. YOUTH RADIO SCHEME

Good progress is being maintained in all States. In Victoria, Howard Rider, VK3ZJY, has accepted the position as Supervisor, Howard is on the Staff of the Technical Planning Branch of the Victorian Education Department. Correspondence on Youth Radio Scheme matters should be addressed to: H. W. Rider, 232 Cumberland Road, Pascoe Vale, Victoria.

Two recently formed clubs in Melbourne are:-

Oak Park High School, Plumpton Avenue, Glenroy, with twenty-three members and Mr R. A. McKenzie as the instructor.

Camberwell Grammar School club, formed by Peter Cole, a non-club participant, who recently passed the Amateur Operator Certificate of Proficiency examination.

A former member of the Kurrumburra High School, Peter Tyers, has gained the A.O.L.C.P. and is now studying for an engineering diploma at Monash University.

WESTLAKES RADIO CLUB

The Westlakes Radio Club, at Teralba, near Newcastle, is now the largest club in Australia catering for both junior and senior Youth Radio Scheme students.

Under the direction of Keith Howard, VK2AKX, assisted by several licensed amateurs in the area (including some who have gained their amateur licence while being members of the club) classes are held on Wednesday evenings and Saturdays.

The membership of the club is now 102, 67 of whom are under the age of 20 years. Several visits have been organised for members; among these were the ABC studios in Sydney, National Broadcasting transmitter at Beresfield, the AWA works at Ashfield and the Mayfield Automatic Telephone Exchange.

A great deal of construction work has been undertaken by adult members in providing facilities for lectures and Morse code training practice.

The new Morse trainer recently installed is now in operation and replaces the original trainer which was not able to cater for the growing numbers wishing to learn Morse code. The new instrument is versatile in operation and is able to supply class, group or individual instruction without interruption to other groups or the main class.

The instructor can speak to any or all of the trainees by microphone over the Morse circuit. The unit, which is fully "solid state," was designed and built by club members.

The individual receiving positions feature partitions for each pupil with a Morse key and full duplicated controls for communication with the instructor. These positions are designed to convert as classroom desks during theory lectures, thus increasing the capacity of the classroom to 30 seats.

The club operates under the call sign VK2ATZ, and can be heard regularly each Monday at 7 p.m. when a resume of the W.I.A. Sunday morning broadcast, together with local news, is given on behalf of the Hunter branch. The call sign used for the broadcast is VK2AWX, the official call sign of the branch.

During the past 18 months, two series of instructional talks entitled "Electronics by Radio" have been broadcast from the club station. The presentation of the news on a Monday night is of a high order and on occasions well-known personalities from local broadcast stations have enjoyed being guest announcers.

Two very successful Field Days held by the club attracted many visitors from Sydney and northern country centres.

Visitors are welcome to call at the club, located almost opposite the Teralba railway station. Those wishing to obtain further particulars on the classes may do so by writing to the Club Secretary, P.O. Box 1, Teralba, N.S.W.

QUEENSLAND

There are now 27 clubs in Queensland registered in the Y.R.S. Several more are under consideration, including the Brisbane Church of England Grammar School, Nambour High School, Emerald High School and St. Brendan's College, Yeppoon.

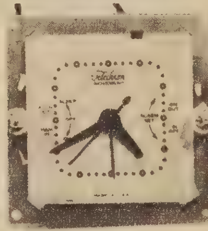
Plans are in progress to cater for the expansion of the scheme and the formation of a larger committee to co-ordinate the various aspects now requiring additional attention and time.

From Western Australia. The Y.R.S. co-ordinator reports that 30 boys at the Christian Brothers College, Leaderville, are very active learning the fundamentals of radio theory. Crystal sets and one-transistor receivers are the current projects.

An enthusiastic group of girls, mostly second and third year students, has been formed at St. Mary's Convent, Leaderville.

A donation of a communications type receiver would be most appreciated by this group.

LAST CHANCE TO SECURE
GENUINE BRAND-NEW AMERICAN "TELECHRON" CLOCK-ALARM-TIMER MOVEMENTS



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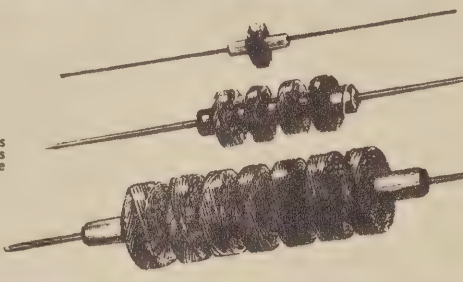

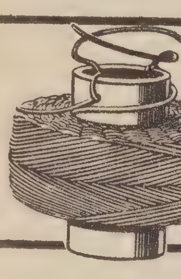

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Illustrated is Aegis stock type S.87 air-cored cross-over network inductor, wound with 18 B. & S. wire. Inductance 1 milli-henry, d.c. resistance 0.6 ohms.
Also available from stock as type S.117, inductance 0.5 milli-henries.

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We manufacture and stock as standard lines practically all the Mullard-designed equaliser chokes and transformers for tape recorders, hi-fi tuners, etc., and are always pleased to quote for "specials."

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A.28

CRYSTAL DIVISION

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NEW LOWER PRICES FOR CLOSE TOLERANCE GOLD PLATED CRYSTALS FOR AMATEUR APPLICATIONS

- 1.8 Mc/s to 14.999 Mc/s ± 0.005% in Style "D" holders, ¼in pin spacing. **Amateur net £2/8/6 each including tax.**
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- 100 Kc/s ± 0.005% in HC13/U holders, ¼in pin spacing* **Amateur net £4/10- each including tax.**
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- 455 Kc/s nominal Crystals for Filter applications in Style "D" or "E" (B7G) holders. **Amateur net £4/10/- each including tax.**

* Specially designed for Crystal Calibrator purposes.

Many other types and tolerances are available from our standard production. Please consult us on your Crystal requirements.

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indicating their own region, i.e. YO8RL/BC.

The administrative regions of the YO land are:

BU—Bucharest City—the capital city of Rumania.
AG—Arges.
BC—Bacau.
BT—Banat.
BV—Brasov.
CJ—Cluj.
CR—Crisana.
DB—Dobrogea.
GL—Galati.
HD—Hunedoara.
IS—Iasi.
MR—Maramures.
MS—Mures—A.M.
OL—Oltenia.
PL—Ploiesti.
SV—Suceava.
RB—Reg. Bucuresti.

Each YO region gives one point of multiplication per band, thus the maximum obtainable multiplier is 85 (5 bands x 17 regions).

For YO stations, the DXCC countries list is the basis for the multiplier, considering the number of countries worked on each band.

10. Final Score: The sum of the QSO points as per rule 8, multiplied by the multiplier as per rule 9.
11. Reporting: Log forms should be filled in separately for each band as follows: Date; Time (GMT); Station worked; Serial numbers (sent/received); Multiplier column (filled in only when a new YO region); and QSO points (one or two).

    A summary sheet is required with information on the final score, operator's name and address, transmitter, receiver and antennae.

    Each contestant must sign a pledge that all the rules and regulations have been observed and that the report is a true one.
12. Certificates:
    (a) Certificates will be awarded to all contestants according to their country classifications and for all modes as per rule 5.
    (b) Competitors working the necessary number of YO DX Club members will get the special award of the club, upon request, and other YO special awards.
13. Deadline: All logs must be postmarked NO LATER than September 1 and addressed to:—
    Central Commission of the Radio Sport (C.C.S.R.), P.O. Box 95, Bucharest, Rumania.
14. The decisions of the Contest Commission are final and the right to change the rules is reserved.

YO AWARDS

In addition to the rules of the "YO" contest given above, the Rumania Central Commission of the Radio Sport have issued details of the various awards, together with the general rules governing such awards. There are twenty awards listed and details of each will be published from time to time. In listing the awards the call sign of the award manager is also shown.

Title	Full Name	Manager
YO-AD	All YO districts	YO3CR
YO-AM	YO Alma Mater	YO3GE
YO-BZ	Balcans peace Zone	YO3YZ
YO-CM	YO Check Mate	YO3CM
YO-DR	Double Call	YO3FF
YO-DX-C	YO DX Club members	YO3RF
YO-LC	Large cities	YO3RO
YO-NC	Namesake calls	YO3VN
YO-2 x 2	2 YO on 2 metres	YO3RY
YO-5 on 5	5 cont on 5 bands	YO3AB
YO-10 x 10	10 YO on 10 metres	YO3AV
YO-15 x 15	15 YO on 15 metres	YO3RG
YO-20Z	Zone 20	YO3CZ
YO-20 x 20	20 YO on 20 metres	YO3JL
YO-25M	Meridian 25	YO3JF
YO-40 x 40	40 YO on 40 metres	YO3YY
YO-45P	Parallel 45	YO3JA
YO-80 x 80	80 YO on 80 metres	YO3ZV
YO-100	100 YO on all bands	YO3JP

GENERAL RULES

All radio amateurs are entitled to these awards, by carrying out the conditions required for each particular award, under the following general rules:

Bands: 3.5MC; 7MC; 14MC; 21MC; 28MC; 145MC.

Mode: CW; AM; SSB; Mixed.

Reports: RST minimum 338; RS minimum 33.

All contacts have to be confirmed by QSL cards, YO cards being in the applicant's possession. (Exception to this rule may be granted for QSLs made during international contests.)

YO awards are not issued for various modes, but each class is a separate award.

The application is of general contest rules type and the logs may be certified either by the awards manager of the applicant's association, or by two licensed radio amateurs having checked the validity of the sighted QSL cards. Thus, the original QSL cards are not needed for checking, but the C.C.S.R. may, at any time, require some cards, or extracts of contest logs, for a direct inspection.

The fee for any award and class is seven international reply coupons. (Packing and mailing included). All short wave listeners may get these awards in accordance with the above mentioned rules. DXCC and WAE officials will be the basis for all YO awards. The awards will be issued only after the YO stations listed in the application logs have received the applicant's QSL card.

When there are fears that some cards have gone astray the applicant is urged to send new QSL cards for the YO amateur with the application. QSL cards must be sent for all YO contacts made during contests. The applicant may obtain, at his request, YO badges at the cost of seven IRCs.

Applications for all awards must be sent to: Central Radio Club, P.O. Box 1395, Bucharest V, Rumania.

DIPLOMA ESCUCHA YEBENES D.E.Y. AWARD

In order to increase the sending of QSL cards to short wave listeners, EA4-957-U issues the D.E.Y. certificate according to the following rules:

Send QSL cards from FOUR SWLs in as many continents, plus TWO "EA" SWLs from January 1, 1960.

It is not necessary to send the QSL cards, but a list duly certified by an Awards Manager is required. Please enclose with application your own QSL card to EA4-957-U, as well as three IRSs to cover sending of the Award.

There are "seals" for one SWL in five continents, plus three EAs. Also, for one SWL is every one of the six continents and three EA's. The "seals" are sent free.

For the Award apply to: Javier Yebenes, EA4-957-U, Ferraz, 30, Madrid 8, Spain.

PIRATES

From time to time, information comes to hand of the unlawful use of another person's call sign by a person who does not hold an amateur operator's licence.

This type of operation is very severely frowned upon by all amateurs as well as the appropriate licensing authorities, and it is pleasing to note that invariably the offender is located.

It is pointed out to persons who may be inclined to engage in this practice, or the use of an unissued or fictitious call sign, that the flexibility of the amateur service makes it relatively easy to locate a station being operated illegally.

Apart from the embarrassment that may be caused to the amateur whose call sign is used, the possibility of the amateur service as a whole being brought into disrepute makes it the most despised type of operation.

From the official point of view, the regulation and penalty for such illegal operation is as follows:—"Except as authorised by or under the Wireless Telegraphy Act, no person shall:—

(a) Establish, erect, maintain, or use any station or appliance for the purpose of transmitting or receiving messages by means of wireless telegraphy, or wireless telephony; or

"(b) Transmit or receive messages by wireless telegraphy, or telephony.

"Penalty — Five hundred pounds, or imprisonment with or without hard labour for a term not exceeding five years."

MORSE CODE PRACTICE

For those persons who wish to learn Morse code or to increase their proficiency, the New South Wales Division provides two excellent services.

A Morse practice session is transmitted each evening commencing at 7.30 p.m. on 3550KC in the eighty metre amateur band. Commencing at 5 words per minute and increasing in steps to 18 words per minute over a thirdy-minute session.

This service is organised by Doug Courtney, VK2AUC, 5 Tanang Street, Bomaderry, N.S.W., Morse Practice Session Supervisor, and assisted by a number of operators rostered for duty on a particular night.

The station call sign is VK2AWI the portable call sign of the N.S.W. division. Doug would welcome reports from those availing themselves of this service.

The second is a Morse practice tape service. This service is conducted by Ern Hodgkins, VK2EH, Mangrove Road, Narara, telephone Gosford 22444.

Morse code recorded on tapes at speeds from 5 words per minute to 20 words per minute, is available on loan for a fee of 25 cents per tape to cover postage, for a period of one month.

Arrangements can also be made for recording to be made on your own tape. Details of type of recorder being used and the recording speed required should be supplied when forwarding tapes.

All inquiries should be made direct to Ern Hodgkins at the address given above. ◘

TEN COMMANDMENTS OF ELECTRONIC SAFETY

1. Beware of the lightning that lurks in an undischarged capacitor lest it cause thee to be bounded upon thy backside in a most ungentlemanly manner.
2. Cause thou the switch that supplies large quantities of juice to be opened and thus tagged, so that thy days may be long on earth.
3. Prove to thyself that all circuits that radiate and upon which thou workest are grounded, lest they lift thee to a high-frequency potential and cause thee to radiate also.
4. Take care that thou use the proper method when thou takes the measure of high voltage, that it not incinerate both thee and the meter; for verily, though thou hast no account number and canst be easily replaced, the meter doth have such and shall bring great woe upon the supply department.
5. Tarry not amongst those who engage in intentional shocks, for they are surely non-believers and not long for this world.
6. Take care thou tamper not with interlocks and safety devices, for this shall incur the wrath of they seniors, and unlease the fury of the safety officer down upon thy head and shoulders.
7. Work not with energised equipment; for if thou doest, thy buddies will surely be buying beers without thee, and they space at the bar will be filled by another.
8. Verily, verily, I say unto thee: never service high-voltage equipment alone; for electric cooking is a slothful process, and thou mightest sizzle in thine own fat for hours before they Maker seeth fit to end thy misery, and draw thee into His fold.
9. Trifle not with radio-active tubes and substances, lest thou commence to glow in the darkness like unto a lightning bug.
10. Commit thou to memory of the prophets, which are written in the Instruction Books; they give thee the straight dope and steer thee away from error.

—Anonymous.

The foregoing observations appeared in a news sheet of a large overseas electronic manufacturing company and contain a message worthy of some deep consideration.

SPECIAL

100 RESISTORS $2

100 assorted new resistors by well known manufacturers in values up to 3 meg from ½ to 3 watt mainly close tolerance and including some high stability types.
Post and packing 20c.

100 CONDENSERS $2

A good useful assortment of 100 new electrolytic mica, ceramic, and paper condensers by well known manufacturers. Ranging from 12 PF to 300 MF. Real value.
Post and packing 40c.

WHIP AERIALS $15

Ex-Army 9ft Tank aerials. Solid bronze insulated base, with helical spring shock absorber. Complete with 3-piece telescoping aerial. Suits car radios or mobile transceiver.
Freight payable at nearest attended station.

LINESMAN'S 'PHONES $10

Long range ex-PMG battery powered linesman's telephones mounted in a strong metal case with a calling magneto and bell. Checked and complete with batteries. Ideal for all intercom applications.
Freight payable at nearest attended station.

ALUMINIUM OFF CUTS

Aluminium sheets offcuts suitable for chassis, panels.
24 x 12½ x 24g .. 40c
13 x 10½ x 18g .. 35c
Post and packaging, 15c.

P.M.G. RELAYS 50c

200, 1,000, 1,300 and 2,000 ohm.
Post and packing, 10c.

METERS 80c

2½in plug in type, 0 to 1 amp R.F. ammeter with internal thermocouple. Moving coil 5 milliamp movement, ideal for experiments or recalibration.
Post and packing, 15c.

METERS $5

Brand new 3¾in diam. English G.E.C. meters. .5-0-.5 milliamp movement with a 50-0-50 scale that can be illuminated.
Post and packing 30c.

RHEOSTAT $1

Rheostats 100 ohm approx. 5 amp. Bronze frame and ceramic former. Measures 4in x 3in x 3in. Complete with knob, these can be easily rewound to personal requirements.
Post and packing, 30c.

VALVES

BRAND NEW IN CARTONS

OB2	75c	6N7	50c
OZ4	50c	6R7	75c
1D5GP	30c	6SC7	50c
1F5G	30c	6SJ7	75c
1H4G	30c	6U5G	75c
1H6G	30c	12K5	75c
1L4	30c	12K7GT	50c
1Q5G	30c	15DQ8	75c
2A3	1.50	35L6GT	50c
2D21	50c	350B	1.00
3S4	50c	393A	75c
6B7S	75c	CV6	30c
6C8G	50c	NU3	30c
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6J7G	50c	VR105	75c
6L6	1.00	VT501A	30c

Post and packing 5c per valve. Post and packing free on orders of 10 or more valves.

9-Pin valve bases	10c
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Diodes 25MA 100 PIV .	10c
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PMG jack sockets	10c
150 Ohm 25W resistors	20c
Push-pull switches	20c
240 volt BC neon indicator globes	30c
Dual pots 10k and 10k	50c
10K pots	20c
250K pots	20c

Please add postage

HARE & FORBES PTY. LTD.

180 George Street, Parramatta, N.S.W. Ph.: 635 9947, 635 6096.
Open Saturday morning — Inspections welcome.
Please print name and address clearly.

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GUITAR AMPLIFIERS

10-Watt, Two Channel, with Twin Cone Speaker, $51.50 (£25/15/).

14-Watt, 4 Inputs, Bass and Treble Boost. 2 Twin Cone Speakers, $59.50 (£29/15/).

17-Watt, Four-Channel. Bass and Treble Boost. Two Twin Cone Speakers, $73.75 (£36/17/6).

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin Cone Speakers, $105 (£52/10/).

60-Watt, 2 Unit
4-12in Auditorium Speakers,

$171.75 £85/17/6

Vibrato with foot control and 2 pre-set controls for frequency and intensity. $10.56 (£5/5/) extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato Control Included.

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SLAP BASS OR BASS GUITAR 40 WATT AMPLIFIER

4 Input Channels. Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

$145.75 £72/17/6

PIGGY BACK GUITAR AMPLIFIER

30 Watt	$79.75
45 Watt	$99.75
60 Watt	$119.75

4 Inputs. Bass and Treble Boost. Vibrato if required. $10.50 extra.

TAPE ECHO UNIT

Suits any Guitar amp.
without any alteration.

JUST PLUG IN

$139.50

REVERBERATION PRE AMPLIFIER

Suits any Guitar amp.
No changes necessary.

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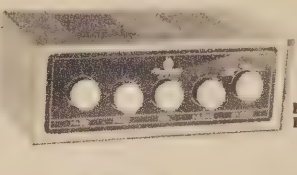
Completely transistorised.

$58.75



PLAYMASTER 4 STEREO AMPLIFIERS

Push-Pull. 8 Watt per Channel. Bass and Treble boost and Cut.

Wired and Tested.

£38/10/- $77.00

T.V. SIGNAL-BOOSTER

240 V. operation. No change. To set. Simple connection. Extra gain on all channels.

$9.75

Post 50c.

NEW RECORDING TAPE

	£	s	d
3in. Mylar LP 300ft.		10	6
5in. Mylar LP 900ft.	1	0	0
5in. Mylar DP 1200ft.	1	5	0
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7in. Mylar LP 1800ft.	1	17	6
7in. Mylar DP 2400ft.	2	10	0
10½in. Mylar LP 3600ft.	3	15	0

Post 2/6 per Spool.

P.A. SPEAKERS

8 WATT

8in. Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

$13.50 £6/15/-

In Double Ended Flares, Duolateral Coverage.

$14.50 £7/5/-

Line Output Transformers to suit. $1.75 (17/6) extra.

P.A. SPEAKER DRIVER UNITS

American Rating. 30 Watts, Voice Coil 16 ohm.

$21.50 £10/15/-

15 Watt Rating.

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REFLEX HORNS TO SUIT.

$21.50 £10/15/-

WEEKEND — HOLIDAY — EVENING DEMONSTRATIONS AT COLLAROY

PHONE XW5956 FOR APPOINTMENT TO TEST STEREO GUITAR AMPLIFIERS AND TELEVISION.

BATTERY CHARGER

240 Volt A.C. Operation

3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

STANDARD

2 amp. 6V, 12V, TRC	$11.50
3 amp. 6V, 12V, TRC	$12.25
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Post., N.S.W. 75c, Interstate $1.25

DE LUXE

1½ amp., 6V-12V	$9.75
3 amp.	$16.75
4 amp.	$19.75
6 amp.	$21.75
10 amp.	$27.75

Rail or Air Freight on.

Complete $28.50

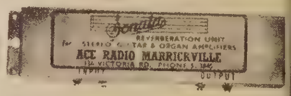
PLAYMASTER BOOK SHELF UNITS

To R, TV & H specifications. Mountain Ash, Maple, Walnut or Teak Formica finish.

ALSO CABINETS ONLY

To suit 6", 8" and 12" speakers

6"	8"	12"
$12.50	$15.50	$17.50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FOR STEREO GUITAR & ORGAN AMPLIFIERS
ACE RADIO MARRICKVILLE
136 VICTORIA RD. PHONE 51-3845
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REVERBERATION UNITS

Latest design to suit organs stereo, guitar, any hi-fi equipment.

£2/17/6 $5.75

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ELEGA REVERB. SPEAKERS

Automatic addition of reverberation to any existing amplifier.
Handles 12 watts.

£12/15/- $25.50

CO-AXIAL SPEAKERS C.S-30. 12"

V.C. 16 ohm. Cross over 3,000 cycle. Frequency range 30 to 20,000 cycles. Rated 20 watts.

£13/19/6 $27.95

C.S-20. 8"

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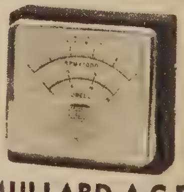
CT-3

2,000-20,000 Response.
20 Watts Power.
Sensitivity 110 dbw.
Weight 1¾lb.

£4/9/6 $8.95



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Wired and tested.

$20.75 £10/7/6

"Electronics Australia," July, August issue. State max. revs., voltage, polarity cylinders.

METER ONLY

$6.75 £3/7/6

INCLUDING DWELL. ANGLE FACILITY

$23.25 £11/12/6

Post., N.S.W., 50c; Interstate, 75c.

A. AMPLIFICATION
C. COMMUNICATION
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B.S.R.

4-TRACK DECK
$35.50 £17/15/-
2-Track, 3-Speed.
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4-Track, 3-Speed. Mono or Stereo.
$45.25 £22/12/6
4-TRACK. 3-SPEED.
3 HEADS.
$49.50 £24/15/-

BRADMATIC HEADS
Latest ½-Track. Hi Fi.
$9.50 £4/15/- pair

4-TRACK or STEREO
Record play back **$11.50** erase **$5.50**

THE NEW COLLARO TAPE DECK

Takes 7in spool.
3 speeds: 1⅞, 3¾, 7½ i.p.s.
2-track, $44.
4-track, $48.
Write for particulars.

TRANSISTOR POWER SUPPLIES

12v. D.C. Input. 300v. 150Ma. Output plus 150v. Output.
$23.75 £11/17/6
12v. D.C. Input. 400v. 150Ma. Output plus 200v. Output.
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240v. A.C. INPUT
9V. 200 M.A. **$4.75**
4.5V. 6V. 9V. 12V. 200 M.A. **$5.75**
9V. 12V. 15V. 22V. 500 M.A.
$7.75
Post: N.S.W., 50c; Interstate 75c.

VARY. A.C.S.

240-270V 50 cycle 5 amp.
Provide infinitely variable AC voltage
$29.50 £14/15/-
2½ Amp as above
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PLAYMASTER 106 AND 107

Feb. and March Elect. Aust.
106
WIRED AND TESTED, **$88.75**
107
WIRED AND TESTED, **$79.00**

TRIO W26 STEREO-TUNER AMPLIFIER

12 watts per channel.
Mag. P.U., Crystal P.U., Tape In-Out, Broadcast, Stereo, S.W. Mono.
$138.00 £69
SEE TRIO. ADVERT.

Transistor-Ignition HI-SPARK

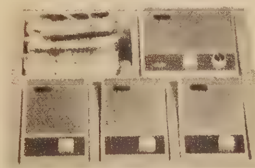
Simple installation.
38 K.V. output.
Complete. Tested.
Negative earth.
$33.50 £16/15/-
Positive earth.
$41.50 £20/15/-
State voltage and polarity.
Post., N.S.W., 75c; Interstate, $1.25.

CITIZENS BAND

27.240 Megs.
10 Transistor Transceivers.
100 M.W. output.
$45.00
1. Watt 13 Transistor 1 channel with squelch.
$65.00 each (£32-10-0)
1 watt. 15 transistor, with squelch provision for two channels. Range to 10 miles under ideal conditions.
$80.00 £40 each

INTER. COM. UNITS

2 Station Transistorised
$11.50 £5/15/-
4 Station, including Master
$20.25 £10/2/6



New Telephone Amplifier

Transistorised.
$11.50 £5/15/-
Post 35c.

T.V. TUNERS

New 10-channel Tuners.
$15.00 £7/10/-
Post 75c.

LATEST 4-SPEED PLAYERS

240V A.C. Mono	$11.50
240V A.C. Stereo	$17.00
Battery Mono	$19.50
Battery Stereo	$21.50
Battery Mono 45 r.p.m. in Cabinet	$9.25

Post., N.S.W., 75c; Interstate, $1.25.

ELECTRIC GUITAR

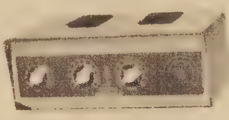
Pickup Units	$8.75
Accordion Pickup Units	$8.75
Harmonica Pickup Units	$1.95

Post., N.S.W. 40c; Interstate, 75c.

Send for full details on Radiogram Chassis, TV and Amplifiers.

AMPLIFIERS

Public Address Range
240V-AC



MINIATURE P.A. AMPLIFIER.
15 WATTS OUTPUT.

Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output	$39.50
30 Watt. As above EL34 P.P.	$53.50
40 Watt. As above EL34 P.P	$79.50
60 Watt. As above EL34 P.P.	$98.50

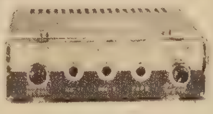
LINE OR VOICE COIL TRANSFORMERS.
MULLARD HI-FI RANGE.

5/10 with pre amp base and treble boost. Ultra Linear output	$43.50
5/20in. As above	$65.50

BATTERY-AC OPERATION

6 valve 6v plus 240v-10 watt	$55.50
7 valve 12v plus 240v-12 watt	$59.75
7 valve 12v plus 240v-25 watt	$71.75

TRANSISTOR P.A. AMPLIFIER C.A.-512



12VDC Operation.
Output 20 watts.
Current consumption at max. output. 2.2 amps.
Input. High imp. mic. Also 600 ohms and tape.
Independent gain controls.
Output: Imp. 4-8-16 ohms.
Freq. Response:
200 cps—6000 cps.
Dimensions: 2in x 6¼in x 8½in.
Complete with instruction book with circuit. All plugs.
PRICE $57.50

DYNAMIC MICROPHONES

DM-391 HI-Imp	$3.50
DM-175 HI-Imp	$4.75
DMS-3 HI-Imp	$5.50
DM-305, 600 ohms or HI-Imp. Suitable stand mounting	$9.75
DM-304. Dynamic Cardioid. 50 ohms or HI-Imp. Suitable stand mounting	$15.75
D.M. 307 HI-IMP.	£7/10/-
CM-10 Crystal HI-Imp. Suit stand mount.	$5.06

Post., N.S.W., 25c; Interstate, 35c.

WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS

Ceramic Units, Sapphire Styli	$7.00
Diamond Styli	$10.50
Universal Ceramic Stereo Cartridge, Sapphire Styli	$2.95
Diamond Styli	$6.50

NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone

8in	$7.00
12in	$7.90
5in	$4.50
5in Tweeter	$3.75
4in Single Tweeter	$2.75
12in Heavy Duty 20 watt	$15.50

P.A. REFLEX HORNS

WITH UNITS

5 Watt 8 ohm	$14.50
10 Watt 8 ohm	$26.50
35 Watt 15 ohm	$18.00

N.B.: As these are American ratings, divide the wattage by 2.

STEREO RECORD CHANGERS

1965 model. 4-speed.
$21.50 £10/15/-
De Luxe Model.
Fully machined and balanced. Heavyweight turntable. Ceramic cartridge.
$27.50 £13/15/-
Post. N.S.W., $1.25; Interstate, $1.75

STEREOPHONIC HI-FI HEADPHONES

With padded earpieces
SPECIFICATION:
Frequency Response: 25-17,000 cps.
Nominal Power 1 watt.
V.C. Imp. 8 ohms each channel.
$7.75 £3/17/6
Post., 50c.

PHILIPS DISC JOCKEY

4-speed Players.
6V, D.C. OPERATION.
MONAURAL CRYSTAL HEAD
$9.75 £4/17/6
STEREO
$11.75 £5/17/6
Post., N.S.W., 75c; Interstate, $1.25.

MORSE KEYS

New lightweight, fully adjustable units
$1.25
As above with buzzer.
Complete Morse practice set.
$1.65

A. AMPLIFICATION
C. COMMUNICATION
E. ELECTRONICS

★★★★★★★★★★★★★★★★★★★ PHONE 51-3845

RADIO

636 KING STREET, NEWTOWN—51-7008

K 20 CT330

K 20 CT500

220S 4000 O.P.V.

D.C. Volts 5, 25, 125, 500, 2500. A.C. Volts 10, 50, 250, 1000. Current: 250uA, 250mA. Resistance: 0-10K, 0.1 Meg.

£3/19/6 Post 5/-

C.T.330 20K.OPV

D.C. Volts, 6, 6, 30, 120, 600, 1200, 3000, 6000. A.C. Volts, 6, 30, 120, 600, 1200. D.C. Current, .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg. 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use. **$15.95** Post., 50c.

C.T.500 20K.OPV

D.C. Volts, 2.5. 10, 50, 250, 500, 1000. A.C. Volts, 10, 50, 250, 500, 1000. D.C. Current, .05, 5.50, 500mA. Resistance, 12K, 120K, 1.2 meg., 12meg. D.B. minus 20 to plus 62.

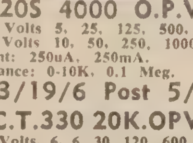
$13.25 Post., 50c.

KAMODEN 370N

100 K. Ohm per volt. D.C. volts. 100Mv. 2.5V. 10V. 100V. 250V. 1Kv. 5Kv. A.C. volts. 2.5V. 10V. 25V. 100V. 250V. 1Kv. D.C. Current 10 Micro. 100 Micro. 1 M.A. 10 M.A. 100 M.A. 1 Amp. 10 Amp. Ohms. 5K. 59 K. 500 K. 5 Meg. 50 Meg. D.B. —20 to +62.

$28.75

Post N.S.W., 75c; Interstate $1.50.



P.T.34 1000.OPV

D.C. Volts, 0, 10, 50, 250, 500, 1000.
A.C. Volts, 0, 10, 50, 250, 500, 1000.
M.A. 1-100-500 RESISTANCE.

$5.25 Post., 50c.

200H. 20K.OPV

D.C. Volts, 5, 25, 50, 250, 500, 2500. A.C. Volts, 10, 50, 100, 500, 1000. D.C. Current, 50uA, 2.5, 250mA. Resistance, 6K, 600K. Capacitance, 2 D.B. Ranges.

$10.50 Post., 50c.

ALL PRICES NET, INC. S.-TAX.

T.E. 40. V.T.V.M. MILLIVOLTER

10 Ranges. 1 MV to 300 V RMS. 10 Ranges. D.B. minus 40 to plus 50 DBM.

$44.50

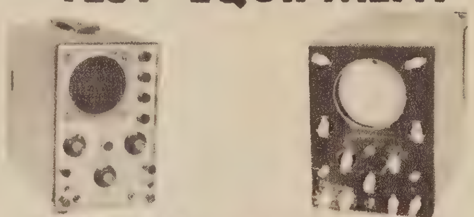
V.T.V.M.

27 Ranges, A.C. Powered.
D.C.V. 0, 1.5, 5, 15, 50, 150, 500, 1,500.
A.C.V. 0,1.5, 5, 15, 50, 150, 500, 1,500 R.M.S.
A.C.V. P. to P. 0, 1.4, 4, 14, 40, 140, 400, 1,400, 4,000.
Resistance, 1 ohm to 1,000 megohm.
D.B. Minus 10 D.B. to plus 65 D.B.

$42.50

Post., $1.
H.V. Probe to 30 KV, $7.75.
T.M.K. Units, $53.50.

TEST EQUIPMENT



WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch $99.75; 5-inch $111.50

T.O.2 TV portable service unit 2" oscilloscope $59.50.

4 CHANNEL MICROPHONE MIXER PRE AMPLIFIER

$7.75
Post., 50c.

TRANSISTORISED VARIABLE POWER SUPPLY

Range to 20V, 200MA

$18.75
Post., 50c.

G.D.O. UNITS

Leader. 810. 6-Band. 2 Meg. to 260 Meg. Nuvistorised. 240 V.A.C. Operation. Modulated. Calibration. Accuracy 2 per cent.

$41.50

T.E. 18 Lafayette. 8 Bands. 360 K.C. to 260 Megs. 240 V.A.C. operation.

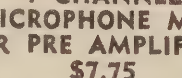
$39.50

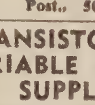
Post., N.S.W., 50c; Interstate, 75c.

T.E. 15 Transistorised, 7 Band, 360 Kc to 270 Megs.

$34.75

PANEL METERS





EDGE TYPE

1 mM. Scaled. S. Meter. Stereo Balance. Tuning. **$2.50**

2" 3" 4" PLASTIC COVERED PANEL UNITS

Latest P series ¾in Barrel 50mmA, 200mmA. 1mA, 10 mA, 500mA, 1 Amp, 10 Amp, 15V. 500V.

From $3.00

MINILAB 7in 1 MULTIMETER

$16.75
Post, 50c.

STEREO PRE AMPLIFIER

240 V. A.C. Power.
To suit magnetic P.U. tape or microphone.
Response: 20 to 20,000 cycles.
Gain 60 D.B.

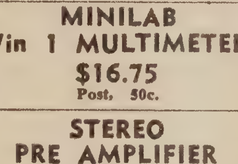
$15.50
Post., 50c.

LEADER SWEEP & MARKER GENERATOR SMG 532

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

$170.00 £85/-/-

Post., N.S.W. $1.50; Interstate, $2.50



T.E. 20 RF SIGNAL GENERATOR

Freq. 120KC—260MCS in 6 bands.
Output (RF)—High 100,000uV max.
Low 100uV max.
Output (Audio)—400 cps approx, 8V.
Modulation — 400 cps internal.
Operation — 240V AC.
Dimensions 7in x 10½in x 5½in.
Weight — 9lb.
Complete with Instruction Book circuit.

$24.50

T.E. 20D, sig and marker gen. 120KC to 500 megs.

$25.50

Post., N.S.W., 75c; Interstate, $1.25.

LEADER SIGNAL GENERATOR LSG 11

240v A.C. Powered.
6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.

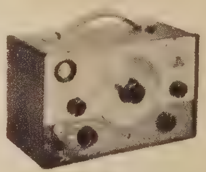
$29.50

Post., N.S.W., 75c; Interstate, $1.25.

SIGNAL INJECTOR

Transistorised. Fountain Pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service.

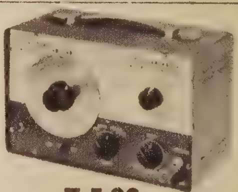
$4.75
Post., 25c.



T.E.46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20 pfd to 2,000 mfd.
Resistance 2 ohm to 200 megs.
Also tests power, factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.
Indications by eye and meter.

$43.50



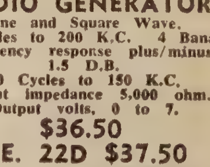
T.E.22 AUDIO GENERATOR

Sine and Square Wave.
20 Cycles to 200 K.C. 4 Bands.
Frequency response plus/minus 1.5 D.B.
60 Cycles to 150 K.C.
Output impedance 5,000 ohm.
Output volts, 0 to 7.

$36.50

T.E. 22D $37.50

T.C. 2



VALVE TESTER

Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.

$26.75

Post., N.S.W., 25c; Interstate, $1.25.

T.E. 50.—99—5011

Checks. Nu Vistas, Compactrons, etc.

$34.25

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Australian Radio DX Club is Growing

The newly formed Australian Radio DX Club is expanding its services, and now has its own session on 3NE Wangaratta, Victoria, 1600KC on Sunday at 1240GMT or 10.40 p.m. Australian Eastern Time. Information on the Club from the Secretary-Editor, Robert Ronai, gives the Club's address as P.O. Box E73, St. James, N.S.W.

The Australian Radio DX Club was ormed in December, 1964, from the Sydney Branch of the New Zealand Radio DX League, and in June, 1965, the Australian lub received permission from the New Zealand organisation to form its own club. Membership stands at 55 and is increasing rapidly, as the only Australian club of its kind gains publicity. A branch in Melbourne has been formed and a further one in Brisbane is planned.

The club publishes its own monthly magazine "The Australian DX News." Anyone who is interested in the Australian Radio DX Club can obtain details regarding membership, and a free copy of the magazine, by writing to the address given above. The club publication covers medium and short-wave, amateur and utility news in its publication.

The voice of Mr John Wing, pictured here, is well known to listeners to the B.B.C.'s World Service, Mr Wing is Duty Operations Assistant/Newsreader with the B.B.C. External Services Program Operations Department, and also presents such programs as "Invitation To The Dance," "A World Of Music" and "Rendezvous With Rhythm."

WNYW — NEW YORK

A new call is now being heard by short-wave listeners. This is WNYW New York, which replaces the familiar WRUL of Radio New York World Wide fame. In fact, in 1936 we heard the station when it operated from Boston as an educational station using the call W1XAL, then it became WRUL and in recent years moved to New York.

Plans were then announced for a move into new studios and installation of new transmitters. The new studios are located at 485 Madison Avenue, New York City; this suite has nine studios and six control rooms and is the largest commercial radio station in North America; the construction of the new transmitting site in New Jersey has started, and is due to be put into service in 1967.

SOUTH AMERICAN SIGNALS

Many of our readers, as could be expected in the winter reception period, report good signals being received from South and Central America during daylight.

A West Perth listener, B. Forknall, reports the signals of HCJB on 9745KC which is providing good reception from 0730 to 1000GMT. The station also uses 6050 and 11915KC and carries the DX Party Line program on the first and third Wednesday of each month at 0930-1000 GMT.

Barry Hewett, Edithvale, Victoria, has observed the familiar TIGHB transmissions of "Radio Reloj" using 6210KC, closing at 0700GMT and broadcasting from San Jose, Costa Rica. The station opens at 1100GMT but at this time signals are much weaker. The station closes with "Ava Maria," and call and slogan "Radio Reloj HB" are frequently given.

Chris Martin of Sydney, N.S.W., has been hearing 4VEH in Cap Haitian, Haiti, using 6120 and 9770KC. The station opens at 1030GMT with a Spanish broadcast and at 1130GMT carries a service in English. The 9770KC channel has interference from Radio Japan using 9765KC.

The Radio Nacional Peru station on 6082KC is heard at 1145GMT after the sign off of Radio New Zealand on 6080KC. The Chilian CE611 using 6110KC has been heard at 1000GMT, but the station suffers some sideband interference from Radio Malaysia using the frequency of 6105KC.

STATION POPULARITY SURVEY

A survey to find the most popular short-wave broadcaster, and also some of the most popular programs heard on short-wave is at present being conducted by DX Inter-National Communications Association of the United States. The world broadcasting award is made following the station survey, and readers are invited to participate in this International popularity poll, according to a letter from the Association.

Readers are asked to submit the names of five of their favourite short-wave broadcasters, in order of popularity. They are also asked to list their favourite in each of the following catagories: best DX and SWL program; news coverage; variety of music and special feature presentations.

The mailing address for the votes is DXI, Box 152, Newton 60, Mass., U.S.A. The closing date for votes is July 31, 1966, and all readers of "ELECTRONICS Australia" who enter the competition will receive a complimentary copy of a book on shortwave antenna systems for their interest in this popularity poll. The survey findings are expected to be known in late August, and will be reported in these pages, when the news is received from David L. Wilson, Director of DX Inter-National.

LATIN AMERICANS LOGGED

The latest record of Latin American stations logged in the present winter season shows the usual pattern of signals in the 49 and 60M band being received from 0300 to 0700GMT, with some strong and interesting signals being received from almost all South American countries.

The latest two new loggings are both from Peru and we have heard these two stations with a late program on Sunday to 0555 for OAZ4R on 4890KC, and to 0700 for OAX3V on 4785KC. The signals of OAZ4R on 4890KC indicate a change in frequency from 4940KC. The station, which is located on Tarma, relays OAZ4P on BC and its slogan is "Radio San Juan, Tarma." The station is affiliated with the Radio Victoria, Lima, network and uses the familiar V sign dot-dot-dot-dash as a station

NEW SCHEDULE OF SWISS BC CORPORATION

The Swiss Broadcasting Corporation in Berne now has three daily transmissions serving the Pacific area during our winter reception period. News of new frequencies and schedule changes are also listed in the Corporation's latest schedule, which was recently put into operation, details of which follow.

The program "Swiss Merry-go-Round," which contains news for the short-wave listener and answers to listeners' letters is broadcast each Saturday, 30 minutes after the opening of each transmission. On the first and third Saturday, news of interest to the short-wave listener is given and on the second and fourth Saturday items for radio amateurs are featured in the program.

0700-0800	Australia and New Zealand	9595, 11775
0845-0945	Africa	15305, 15430, 17830
1145-1315	United Kingdom	9665, 11865
1330-1500	Asia	11855, 15305, 15395, 17830
1515-1645	Near East	11880, 15255, 15305, 17830
1845-1945	United Kingdom	7110, 9665
0115-0245	North America	6120, 9535, 11815
0115-0245	Australia and New Zealand	11775
0415-0515	North America	9535, 11715
0415-0515	Australia and New Zealand	9595, 11775

SOUND PROJECTORS

Cinevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.

$115.00

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each. Post 10c

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder.

$1.85 each

Post: N.S.W., 30c: Interstate, 40c.

PMG TYPE TELEPHONES

Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line. Complete with 660ft wire.

$23.00

(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

AERIAL CAMERAS

F.24 Mark IV 2.9 Lens, stops 11, 8, 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.

$39.00

50c Cartage to Rail. Freight payable at nearest attended railway station.

SHIPS' CLOCKS

(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite

$30

Post N.S.W., 70c; Interstate, 95c.

ECHO SOUNDER

Depth and Fish Finder. Transistorised, with Neon Flasher Indicator, complete and Guaranteed.

$85.00 Post $1.60

12 CREED TELEPRINTER

Tape printers model 47.R, 240 Volts operated.

$35.00

TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile). $7.00 per coil.
Post, N.S.W. 70c; Interstate $1.20.

3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

2-WAY RADIO

NUMBER 22 (AUST.)

Untested without meter or leads, with power supply less relays. $15.00. 50c cartage to rail. Freight payable at nearest attended railway station.

AMPLIFIER

Subminiature 4-Transistor, Audio Push-Pull.

$7.00 Post 50c

GOOSE NECK LAMP

NEW. IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.

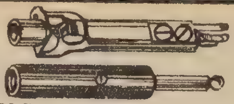
$1.25

Post and packing, $1.00.

DRAFTING MACHINE

Genuine Swiss-Wiles (Without Scale).

$19.50 Post $1.20



P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

NIFE CELLS

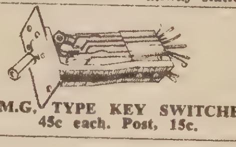
1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

$1.00 each

Post, N.S.W., 25c; Interstate, 35c.
1.2 volts 15 AH, 8in x 4in x 2in, $2.95.
2.4 volt 10 AH, 6in x 2½in x 2in. $2.50.
Post, N.S.W., 30; Interstate, 40c.

PERSPEX

Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.



P.M.G. TYPE KEY SWITCHES.
45c each. Post, 15c.

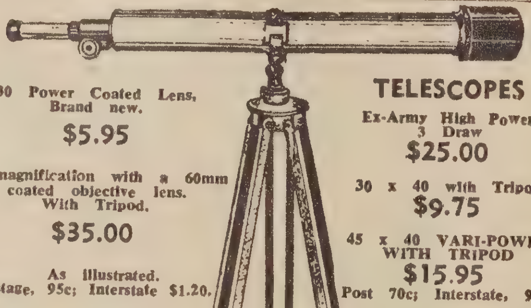
VALVES

BRAND NEW

IN CARTONS.
Special discount for quantity

6SN7GT	95c	6AG5	50c
89	$1.00	X61M	$2.20
12SA7	$1.25	CV850	$1.50
6H6	45c	18H6G	30c
41	$1.25	832	$5.00
5U4G	95c	6F13	75c
77	$1.00	6AK5	$1.50
VR150-30	$1.00	6X4	$1.00
		6F8	75c
5CPI	$3.95	6N7	$1.00
EF50	35c	12SK7	50c
6U7	75c	VR1120	50c
V1103	$1.00	VR118	75c
VH120	75c	VR65	25c
1L4	$1.0	6R7GT	50c
5Y3	$1.25	VT4C	75c
6C4	50c	AU5	$1.00
CV2184	$2.25	80	$1.25
		6AK5W	$1.50

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 Power Coated Lens, Brand new.

$5.95

60 magnification with a 60mm coated objective lens. With Tripod.

$35.00

As illustrated.
Postage, 95c; Interstate $1.20.

TELESCOPES

Ex-Army High Power 3 Draw

$25.00

30 x 40 with Tripod

$9.75

45 x 40 VARI-POWER WITH TRIPOD

$15.95

Post 70c; Interstate, 95c.

HIGH STABILITY RESISTORS

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reak, as well as music featuring these entification notes in all station announ- ements.

The second station is OAX3V which elays OAX3U on BC, and is using 4785KC close at 0700 with the Peruvian Nat- nal anthem. This station has its announ- ement on tape, which is repeated after ach recording, backed by a series of himes. The station uses the slogan "Radio lorizonte," and is located at Tingo Marie, eru. The program is typical Latin Amer- an dance music, and each item is fol- owed by the recorded announcement, with fuller station identification when the tation signs off the air at 0700GMT.

Two Colombian stations with good sig- als, which are on the air all night, are IJAE Radio Santa Fe in Bogota using 965KC and HJFW Radio Manizales, in Aanizales, Colombia, which uses 5020KC. Both these stations can be heard at 0800- GMT, but at times suffer from CW inter- erence.

BONAIRE RELAY

Radio Nederlands announcement that a elay station is to be built at Bonaire, Netherlands Antilles, has been followed with more details on the proposed station. The relay station on Bonaire will have two 50KW transmitters, and the antenna sys- em will beam the energy in the direction of North, Central and South America, and Africa. Modest studio facilities will be pro- vided and some 25 people employed at the station, most of them being Antillians.

This is a major effort to improve recep- tion of Radio Nederlands programs in these areas. The idea of building the transmitter at this site is that the island is favourably situated for transmissions to these areas, being close to the equator and providing good propagation conditions. The transmitting site will give better propagation than the key station in Holland, which is situated 52 degrees north and in Europe, one of the most densely packed areas not only in terms of population but also of the use of radio frequencies.

At Bonaire, the station will be one of relatively few stations on the international short-wave bands in the Caribbean, and will afford a much bigger chance of undisturbed reception, when advantage is taken of the prevailing propagation conditions. The island is small, surrounded by sea, and has a good earth.

The programs will be recorded at the Hilversum studios in Holland, and flown to Bonaire a few days in advance. News can be sent to Bonaire with the help of Telex and cable when the topical programs are not of sufficient quality for relay, and will be broadcast from the Bonaire studios. It is expected it will take two years to put the station into service.

FLOATING RADIO STATION

It is understood the B.B.C. in London has plans to put into operation a floating radio station, located on a ship in the Mozambique Channel, to beam programs to Rhodesia. The reason for this move is that the temporary B.B.C. relay station at Francistown, Bechuanaland, some 16 miles from the Rhodesian border, is suffering from heavy jamming to the signals received from London, and is too close to Rhodesia to override the interference.

The present Francistown relay station carries programs from the B.B.C. London on 926KC BC and 4845 and 7295KC. The 926KC transmitter operates 0400-0800, 0900-2000, while on SW 4845KC the transmitter is on 0400-0800, 1700-2000, and on 7295KC from 0600-0800 and 0900-1700 G.M.T.

CLANDESTINE RADIO STATIONS

Recently the Radio Canada Short-Wave Club devoted time in a session to give information about and recordings of the clandestine radio stations, so called "freedom" stations which are frequently heard by listeners. The location and operation of these are difficult to find out, even after extensive listening.

Among the most interesting stations included was "Voice of the Blue Eagle," which has been heard in the United States on 19100KC at 1815 G.M.T. It is understood this station is one of several being tested in the United States by the U.S. Navy from a Constellation aircraft in flight, for future use over Vietnam where it will broadcast radio programs in English and Vietnamese. Another station which is widely heard plays "Kiss Me Honey" continuously. This is a jamming station used to interfere with "The Voice of Iraqi Youth," and is evidently a Communist station. The "Kiss Me Honey" station operates on 11690 and 9650KC. Recently "Kiss Me Honey" has been replaced on this station by "Can't Buy Me Love" sung by the Beatles.

Two medium wave stations, Freedom Radio 904 and German Forces 935, are located in Eastern Germany, but these two stations try to give the impression they operate from Western Germany and use 908 and 934KC. "The Voice of the Iranian People" is one of the newest pirate stations. This is on 7082KC and appears to be located in Albania. Radio Portugal Libre, is frequently heard, and is presumed to operate from Algiers.

RADIO NEPAL TO HAVE 100KW

Radio Nepal is soon to boost its power to 100KW, and will then be heard much more strongly throughout Asia. The new transmitter, which will be installed later this year, is required to give country-wide coverage and enable Nepalese nationals abroad to keep in touch with news and events in their home country.

The new Marconi 100KW transmitter to be installed is of a type used by many countries throughout the world, and similar to those used by the B.B.C. The transmitter has a frequency range of 5,900 to 26,000KC, so it will be able to operate on the international bands. Mr P. G. Cadney of the B.B.C. in London has been seconded under the Colombo Plan as broadcast adviser to the Government of Nepal. The first broadcasts from the new transmitter are expected on the air from Katmandu, Nepal, later this year.

BROADCAST STATION SCHEDULE CHANGES

PRAGUE USES 6090KC.

Radio Prague, Czechoslovakia, has started using the new channel of 6090KC in its service to North America, 0330-0430GMT. This new frequency suffers from interference from the A.B.C., VLI6, in Sydney and also a Russian Home Program transmitter. The schedule now in effect from Radio Prague remains in operation till Sept. 16th. Major changes in the English language transmissions are listed below:

0700-0800	Australia, New Zealand	6055, 9505, 15230, 15285, 21450
1200-1230	Europe	9505, 11960, 15285
1900-1930	Europe	5930, 7345
1530-1630	Africa	6055, 7345, 9550, 11990
1730-1830	Africa	5930, 7345, 9550, 11990
0100-0200	North America	5930, 7115, 7345, 9505, 11990
0330-0430	North America	6090, 7115, 7345, 9505, 11990

RADIO NORWAY—OSLO

The new transmission schedule from Radio Norway which is in force until the end of August includes the use of the complete range of frequencies in the international short wave band, except for 11 metres, which it has dropped for this period of the year.

0300-0430	North and Central America	15175, 11850, 9610
0745-0815	Pacific and Africa	21730, 17825, 15175, 11850, 9610
1100-1230	Far East, Europe	21730, 17825, 15175, 11850, 7210
1300-1430	North America, South Africa	21730, 17825, 15175, 7210
1500-1630	United States, Africa	21730, 17825, 15175, 11850, 9610
1700-1830	Africa, South America	21730, 17825, 15175, 11850
1900-2030	Europe-East Africa	21730, 17825, 15175, 11850 and 9610
2100-2230	Americas	21730, 17825, 15175, 11850
2300-0030	North Atlantic, Americas	17825, 15175, 11850, 9610

NORTH KOREAN BROADCASTS

A program schedule from Radio Pyongyang gives the latest schedule of the North Korean Radio, and this schedule gives the frequencies in which transmissions are carried. In the past the station listed only its metre bands on which broadcasts were carried. The present transmissions in English from the Korean Central Broadcasting Station, Pyongyang, are as follows:

1900-2000	Near and Middle East and Africa	6540, 7580
0400-0500	Near East, Africa	14520, 15520
0800-0900	South East Asia	7580, 13780
1100-1200	South Asia	7580, 13780
1400-1500	South Asia	7580, 13780

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☐ "Fundamentals of Transistors RCA Service Company, £7/10/- ($15.00).

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FLASHES FROM EVERYWHERE

KIGALI relay station of the Deutsche Welle at Cologne, which gives the service to Africa from this base in the Rwanda, is reported by Michael Byrne of Charters Towers, Queensland. The signals on 11905KC have in recent weeks undergone some schedule changes and our most recent reception has been at 0545GMT when the station has been heard opening transmission for the day. The station's interval signal is heard from 0540 hours and transmission opens with full station identification at 0545GMT. The BBC London also has transmission on the same frequency with the result that interference is often encountered on the channel.

ALBANIA over Radio Tirana has a new transmission to North America. This program is on the air 0230-0300GMT, and uses the frequency of 9525KC. North American listeners report that the frequency drift is considerable, and at times the station is as high as 9530KC in this new English transmission. Tirana is also heard at 0630 in English on 7265KC.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Greenwich Mean Time, add 8 hours for Perth, 10 hours for Sydney, 12 hours for Wellington time. All frequencies are in kilocycles.

KIEV RADIO in the U.S.S.R. has a DX session in its English transmission, which will be on the air on June 27 and July 28 as part of the English programs which are heard to Europe 1900-1930. Radio Kiev is then using 6020 and 9640KC, and the same program is repeated at 2230-2300GMT.

REUNION station ORTF St. Denis has added the frequency of 3205KC to its short-wave outlets, it is now carrying its programs on 2245 and 4820KC. The station has been heard closing on these frequencies at 1830GMT with a program in French.

CANADIAN station CFVP which is a commercial private broadcaster in Calgary, Alberta, and has the slogan "The Voice of the Prairies," is being reported on 6030KC at much improved signal level. The station is listed to use 100 watts. The station relays a BC station CFCN in Calgary. Signals are heard from 0300 to after 1000GMT in their all night transmissions.

JAPAN has a new time for its service to North America from Tokyo, and is now on the air 2345-0045 on 15135, 11780KC. The service to North America West Coast is from 0200 to 0300GMT on 17875, 15235 and 15135KC.

SINGAPORE site of the Forces Broadcasting Service has been noted by Bill Hawthorn of Warnambool, Victoria, using 5010KC and at good level at 1100GMT. This Forces station has a news bulletin at 1100GMT, and carries both English and local language programs.

LATIN AMERICAN signals are being reported at good level by Chris Martin of Croydon, N.S.W., who is hearing the Dominican Republic station, Radio Television Dominicana at Santo Domingo, opening at 1100GMT on 9503KC. The station opens with an anthem and announcement, then follows Latin American music with sideband interference from Radio Japan using 9505KC, but from 1130 the frequency is free from any interference.

ARGENTINA station Radio Nacional has Japanese from 0900GMT when using 9690KC and at good signal level, and the station interval signal opens the transmission in Japanese. A Bolivian station on 9555KC opening at 1100GMT is spoilt at 1130GMT by the VOA transmissi using an adjacent channel. The Bolivi station is believed to be "Radio Illiman in La Paz.

STOCKHOLM in Sweden now has additional program to South Ameri This is broadcast for morning recepti in the area, and is on the air 0900-09 on 9625KC. Radio Sweden in its tran mission to Australia and New Zealand poor in our winter months at 1100GM when on 11810 and 15190KC. B reception is at 1945GMT, in the servi to Africa on 11705KC.

BONAIRE station of Trans World Rad in the Netherlands Antillies now has DX program, called "The DX Special which is on the air at 0335GMT Sunday on 11820KC, and provides goo reception in the Pacific, but reports fro Europe state that this session, being u suitable to listeners in that area, may retimed.

RED LION station WINB (standing f World International Broadcasters) at Re Lion, Pennsylvania, U.S.A., has verifie Samson Voron of Coogee, N.S.W. Th present schedule of the station shows tha they operate 1700-2000 on 17720KC an from 2002 to 2200GMT they us 11795KC. The transmissions are dail and the station has the power of 50KW They relay the medium wave program and carry some of their own originate programs.

BROADCAST BAND NEWS

AUSTRALIA — Further information i now available on the proposed four ne stations for the Australian Broadcastin Commission reported in these pages som months ago, and full details on call, location, power and frequency are now assigned

2CP	Cooma, N.S.W.	50W	1570KC
6BE	Broome, W.A.	50W	670KC
6PH	Port Hedland	2KW	600KC
6BS	Bussellton, W.A.	2KW	760KC

ETHIOPIA—The reception of a new high-powered transmitter in Addis Ababa i Ethiopia on 840KC with a test transmissio has been a new country for listeners, sinc it was first reported as heard by Invercargill N.Z., listener Merv Banks. The station ha been heard with test transmissions from 1700 to after 1800 G.M.T., which has been up to dawn in New Zealand. The station plays English recordings and gives announcements in English to the effect that this is a test transmission from Radio Addis Ababa and operating on 840KC with the power of 100KW. The signals have been best received on Sunday morning in New Zealand, 1800 Saturday G.M.T. The NZBC station 2XB Masterton does not open at 1800 G.M.T. on that day, leaving the frequency clear for the Ethiopian station when reception is most favourable.

INTERNATIONAL WATERS — Radio Caroline South is now on 1187KC, while the Cheata 2 station, now known as Radio Caroline West, will be on the air soon. The Caroline South station has boosted power to 50KW. United States interests are to put into operation, after fitting out in the U.S.A., a vessel which houses two stations, Radio Britain and Radio England, one with a service of light music and the other of popular music. The Dutch off-shore station Veronica has made such an impression on the Dutch radio scene, and been so heavily supported by its commercial sponsors, that the Dutch Government will permit commercial announcements on a limited number of their stations from October 1.

TECHNICAL BOOKS AND PUBLICATIONS

RANSISTOR ENGINEERING, and Introduction to Integrated Semiconductor Circuits. By Alvin B. Phillips. Published by McGraw-Hill Book Co., New York, 1962. 373pp., 6 x 9¼in, hard covers. Many circuits and diagrams photographs. Price in Australia $13.15.

As author Phillips explains in his preface this book, his aim in writing it has een to provide the engineering student nd graduate engineer with a basic explanaon of the principles of transistor theory nd design, and the relationship of all easured electrical characteristics, to the hysical properties of semiconductor aterial. It is not meant to deal with emiconductor process technology, nor with e design of circuits employing semionductors, but to provide a solid groundork upon which such material can be tructured.

Within the field thus defined the author eems to have done a fine job. The book resents just about all the material one vould expect to find, in a manner which hould satisfy the most critical. Topics are reated in logical order, clearly yet with o sacrifice of rigour.

In keeping with his professed aim the uthor has naturally found it necessary to ssume a mathematical and physical background: approximately that possessed by enior engineering and science students. Hardly a book for technicians or hobbyists, hen.

A listing of the chapter headings should ive a good idea of the contents and their resentation order: 1. Transistor Processes nd Types. 2. Atomic Structure and Energyand Theory. 3. Semiconductors. 4. Properies of Semiconductor Crystals. 5. P-N Junction Theory. 6. Characteristics of P-N Junctions. 7. Introduction to Transistors. 8. Junction Transistor Theory. 9. Characteristics of Junction Transistors. 10. Highcurrent Transistor Characteristics. 11. Lowrequency Feedback Effects. 12. Low-frequency h Parameters. 13. High-frequency h Parameters. 14. Frequency Response of Transistors. 15. Junction-transistor Amplifiers. 16. Junction - transistor Switches. 17. Transistor Design Principles.

The final chapter discusses grownjunction, alloy, diffused-base alloy, mesa, planar and epitaxial transistors, and gives a brief introduction to integrated circuits.

Each chapter concludes with a small set of self-tutorial problems and a list of selected references.

In all, "Transistor Engineering" seems a well-written and presented volume covering an important section of semiconductor theory. It would be eminently suitable for use as a university or college text, and as a reference for the engineer.

Our copy came direct from the publisher, but copies are available at the larger bookstores. (J.R.)

* * *

CATV SYSTEM ENGINEERING, by William A. Rheinfelder. Published by TAB Books, Thurmont, Maryland, 1966. Spiral binding, 5½ x 8½in, 206 pp., many diagrams. Price quoted $9.95.

A rather specialised little volume, this, covering the design and planning of cable TV systems. It will be of interest mainly to technicians and engineers in this field, although a limitation is that the systems used for discussion are mainly those used in the U.S.

The title headings are: 1, CATV System Concepts. 2, Head End Design. 3, CATV Amplifier Characteristics. 4, Optimum System Spacing. 5, Practical Aspects of Spacing. 6, Level Diagrams for System Design. 7, Matching and Reflections. 8, Amplifier Controls. 9, Automatic CATV. 10, Testing CATV Amplifiers.

Six appendices cover useful calculations, data tables and charts. Throughout the presentation is straightforward and concise.

Our copy came direct from the publishers, and no information is to hand regarding local availability. (J.R.)

* * *

SEMICONDUCTOR CIRCUITS HANDBOOK, Volumes I and II. Published by Techpress, Inc., Brownsburg, Indiana, U.S.A., 1965. Soft covers, 9in x 6in. Volume I contains 191pp. and Volume II 127pp. Many circuits, with some diagrams. American prices are $2.95 and $1.95 respectively.

Volume I is divided up into five sections, the headings of which are, Direct-Coupled Amplifiers, Audio-Frequency Amplifiers, High-Frequency Amplifiers, AF and RF Oscillators, and Switching Circuits.

Similarly, Volume II is divided up into four sections, the headings being, Power Supplies and Regulators, Power Converters, Logic Circuits, and Non-Linear Circuits.

Although this work is in two volumes and, no doubt, may be purchased separately, I find it convenient to treat the work as a whole for review purposes. No information is to hand as to authorship or who compiled the information. The only reference along these lines appears in the Introduction which reads, "Portions of this book were reprinted from Department of Defence MIL-HDBK-215."

The presentation is similar to that of many other low-priced books, in that an offset system of printing is used. However, it is none the worse for the fact.

Each section has its quota of circuits with descriptive matter and a general rundown on the performance of the particular circuit. This could amount to anything from one half to about three pages.

Each section covers quite a wide range of circuit treatment of the subject and as such, could be a veritable reservoir of information and ideas on which could be built somewhat more complex pieces of equipment. In short, personnel engaged in design and development may find many useful ideas on which to build. Advanced amateurs and experimenters should also find useful information in these volumes. It should be pointed out that no constructional details are given, which after all, is not the purpose intended.

Just to give some ideas to the quantity of material included, here is a list of the sections with the number of circuits contained in each.

VOLUME I:

Section I, seven circuits; Section II, 16 circuits; Section III, 10 circuits; Section IV, 14 circuits; Section V, 24 circuits.

Special mention should be made of the last section. This contains many circuits of flip flops, multivibrators, Schmitt trigger, blocking oscillators, etc.

VOLUME II:

Section I, 14 circuits; Section II, seven circuits; Section III, 13 circuits; Section IV, five circuits.

Section III contains circuits for different types of "gates," ring counters, a shift register, etc.

Our copies came directly from the publishers, but it is reasonable to assume that they should be available from large booksellers, either immediately or in the near future. No Australian price is available at the time of writing. (I.L.P.)

ELECTRONIC CIRCUIT DESIGN HANDBOOK, by the Editors of EEE Magazine, Published by TAB Books, Thurmont, Maryland. Cloth bound, 11 x 8-5/8in (Demy 4to.), 254 pp., with many circuits and diagrams. Price quoted $14.95.

This book is a fairly good example of the "selected circuits" compilations which seem to be so popular in the U.S. It features a great many circuits (approximately 350, I would estimate), each accompanied by a short explanation and note. In some cases the notes amount to a few hundred words; in others only a few paragraphs.

The contents are divided into 19 sections, titled respectively: Control Circuits — Regulator Circuits — Protection Circuits — Filter and Suppression Circuits — Pulse Circuits —Comparison Circuits — Amplifier Circuits — Oscillator Circuits —Indicator and Alarm Circuits — Counting and Timing Circuits — Test and Measurement Circuit — Generator and Simulator Circuits — Converter and Inverter Circuits — Power Supply Circuits — Detection and Sensing Circuits — Display and Readout Circuits — Gating and Logic Circuits —Relay and Switching Circuits — Miscellaneous Circuits.

As some of these titles may suggest, the material is at quite a high level; the circuits also seem to be quite up-to-date, with many featuring such devices as the unijunction, FET, symmetrical transistor, silicon-controlled switch, Shockley diode, Raysistor, etc.

In short, the book could prove quite useful to design engineers and technicians as a source of ideas, and possibly to the advanced hobbyist as a means of insight into modern trends in electronic design. Apart from these applications its appeal would be rather limited.

Our copy came direct from the publisher, and no details were supplied regarding local availability. (J.R.)

* * *

TESTING DC MOTORS AND GENERATORS by Samuel Heller, P.E. Published by TAB Books, Thurmont, Maryland, U.S.A. Paper covers, 62pp., size 5 by 8½in. Our copy from the publishers; price quoted $2.50.

A relatively small book, the contents originally appeared as a series of articles in VOLT/AGE magazine. The author's in-

become an expert in Amateur Radio

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A.C.E. RADIO

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ELECTRONICS

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19 Plate. 150 Amp.
Dry Charged. Cells.

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32V and 110V.
High Speed, Series Wound.
1/8 h.p. motors.

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1C6	$1.25
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1M5	50c
1N5	75c
1Q5	50c
1T4	$1.00
6AR6	$1.25
6AS7	$2.00
6B6	75c
6B8	75c
6BF6	$1.00
6BL8	75c
6BM8	75c
6C8	75c
6F6	$1.00
6G6	75c
6G8	$1.50
6J6	$1.00
6J7G	75c
6J8	$1.75
6K6	75c
6K7	50c
6N7	75c
6SA7 Metal	75c
6SC7	$1.00
6SH7	40c
6SJ7	95c
6SK7	$1.25
6SN7	75c
6SS7	$1.25
6X5	75c
7C5	50c
7N7	75c
7W7	50c
12A6	50c
12AT7	$1.00
12BE6	$1.00
12BH7	75c
12C8	$1.25
12SJ7	$1.25
2A3	$2.00
2C26	75c
2X2-879	50c
3A4	$1.25
3B7	$1.00
3D6	$1.00
5X4	50c
5Y4	50c
5Z4	$1.00
6AC7	75c
6AG5	95c
6AG7	$1.00
6AJ5	50c
6AK5	$1.00
6AL5	75c
6AM5	75c
6AM6	75c
6AN5	$1.25

12SK7	50c
12SL7	$1.25
47	$1.25
76	75c
84/624	$1.25
723A	$6.00
807	$2.00
809	$1.75
813	$7.00
829B and Socket	$5.75
866A	$1.50
954	50c
956	50c
1603	50c
1616	50c
1619	$2.00
1629	50c
1050	$2.00
9006	50c
AV11	25c
CA19	$10.50
CK1013	$1.50
CV63	75c
CV66	75c
CV1102	75c
CV1133	75c
CV1136	75c
EBC33	75c
EC70	40c
ECH33	$1.50
EF36	75c
EF37	75c
EF39	75c
EF72	40c
EF73	40c
EK32	$1.50
EL91	$1.00
EM35	75c
KTW62/6U7	75c
RL27	$1.50
VR65	50c
VR75/30	$1.50
VR105/30	$1.50
VR150/30	$1.50
VT502	$1.25
32	$1.00
42	$1.00
45	$1.00
37	$1.00
49	$1.00
53	$1.00
59	$1.25
89	$1.00
77	$1.00
CL4	$1.25
EM1	$1.25
TZ40	$1.00
6AB7	75c
6C6	$1.25
6SC7	75c
7A6	75c
9006	50c

GENEMOTORS

Input	Output		
12v	600v 300mA	New	$11.00
12v	500v 350mA		$17.00
12v	1200v 200mA		$13.00
24v	250v 100mA	New	$4.00
24v	540v 200mA	New	$4.00
24v	300v 250mA	New	$5.50
12v	275v 110mA		$7.50

CHASSIS PUNCHES

SIZES ⅝", ¾", ⅞", 1".
1⅛" with tapered
Reamer and Carry Box.

$5.75 £2/17/6

Post 50c, Interstate $1.00.

NEW POWER TRANSFORMERS

1960 5in CRO	$11.75
325 x 325 150MA	$9.50
285 x 285 300 MA	$14.70
800V and 270V 300MA	$15.00
240V-110V 1.3KVA Auto	$21.00
150 x 150V 30 MA	$2.75
225 x 225V 40 MA	$3.00
124V Doubler 300MA	$6.75
130V Doubler 400 MA	$7.75
145V Doubler 450 MA	$9.75
150V Doubler 500 MA	$10.75
220V Doubler 600 MA	$14.70
310 x 310 170 MA	$4.95

3" SELSYN MOTORS—TRANSMITTERS

50 V AC — 50 cps.

$5.75 £2/17/6

Post 75c, Interstate $1.00.

RELAYS

6V, 3-pole Miniature	$1.50
12 volts, DPDT, 5 amp	$2.00
12 volts DPDT	$1.25
100pf TX var. condensers	$1.00
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PMG TYPE 3000

2000 ohms, $1.25
1000 ohms, $1.25

Lapel Crystal Mikes	$1.25
Crystal Mikes with switch	$1.50
Telephone Pick-up Units	$1.25
Contact Pick-up Units	$1.50
100UA Stereo Bal Meters	$3.50

OIL FILLED CONDENSERS

.5mfd 600V	35c
2mfd 600V	65c
1mfd 600V	65c
4mfd 600V	65c
4mfd 2.5K	$3.00
1mfd 3000V	$1.70
.5mfd 5K, .1 5K, .1 3K AC .25 4K, .5 2½K ea.	$1.50
4mfd 3000V	$3.50
2mfd 3000V	$2.50
1mfd 3000V	$2.00
1.25 mfd. 6000v.	$4.50
mfd. 4000v	$3.00
2 mfd. 2000v	$1.50
4 mfd. 1500v.	$1.50
1 mfd. 1500v.	$1.00
8 mfd. 600v.	$1.00
1 mfd. 1000v.	$1.00

PYE REPORTER

2-way Vehicle Band Transceivers.
Ex-Taxi Cabs.
12 volt, 70 meg. Complete with valves and speaker.

$33.75 £16/17/6

NEW C.R.O. TUBES

3API-906 3in	$2.75
CV112 5in	$2.00
VCR97 6in	$3.75
ACR10/VCR139A 3in	$3.00
CV1522 1¾in	$2.25

6" INDICATOR UNITS

TYPE 1A
Suitable for C.R.O. conversion.
Circuit supplied.

$20.75 £10/7/6

NEW 3-GANG CONDENSERS

300 PF+ 200 PF+ 60 PF

75c 7/6

NEW HEADPHONES

5 Ohm	$2.25
2000 Ohm	$2.25
4000 Ohm	$2.50
American Lightweight	$1.25
Australian DLR	$1.25
Dynamig Earpieces, pr.	45c

Post 25c pr.

NEW STAND LAMP

18" Goose neck complete with shade. 3-core flex, plug and switch. Ideal for machine light, music light, reading lamp, table or TV light.

$1.05

Less shade 75c. Pack. and post., N.S.W., 75c; interstate $1.05.

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Communications Receivers. Test equipment. P.A. Gear. Large or small surplus stock. Best prices. Call, write or phone, any time.

TRANSISTORS

2N174	$5.00
2N442	$4.50
2N441	$4.00

High-powered units for 75-watt audio, 200-watt power units or transistor ignition.

NEW VALVE SPECIAL

In lots of 50 only.
5Y4. 5X4, 1616. 6K7.
$15.00 plus Freight.

60ft. extension speaker leads with miniature plugs or suit indoor aerial wire.

35c. Post 5c.

NEW G.M.F.

1/8 H.P. 240V-A.C. Motors.
2 speed. Reversible.
Capacitor Start.
Double ended drive.
Ball bearings.

$5.50 £2/15/-

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Square. Clear Plastic.

2¼in 50 UA	$4.75
3⅝in 50 UA	$5.75
2¼in V.U. Meters	$4.75
3⅝in 1mA	4.75
2¼in 500V. A.C.	$4.25
2¼in 500V. D.C.	$3.50
3⅝in 500V. A.C.	$5.75
3⅝in 500V. D.C.	$5.00

Post N.S.W. 25c, Interstate 40c.

INTER COM TELEPHONES

15 Line Connections.

$7 £3/10/- each

PILLOW PHONES

Low Imp. VC Matchings.
Ideal Hospitals, etc.

$1.75 17/6 each

NEW

TRIO COMMUNICATIONS RECEIVERS

9R59.D.E. SIDE BANDER

9 Valves. Mechanical Filter. New Design. New Bandspread.

$159.50

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As described in Trade Review this issue.

$89.00

Wired, Tested and Guaranteed.

$99.00

Other models see May issue.

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AIR TESTED. PERFECT ORDER.
6v. Operation. 6 Band.
200 K.C. to 30 Megs.
Ideal communications Receiver or mobile and small ships' use.

$55.00 £27/10/-

3BZ TRANSMITTERS

12V Operation. 15 Watt O.P.
2 to 9 Megs.
Air Tested. Perfect order.
Suit small ships, Bush Fire Brigades, Island Services.

$55.00 £27/10/-

522 TRANSCEIVERS

Complete With Valves.
100 to 156 Megs.

$25.75 £12/17/6

522 TRANSMITTERS

Complete With Valves.

$13.50 £6/15/-

522 RECEIVERS

Complete With Valves.

$11.50 £5/15/-

NEW ROTARY CONVERTERS

160 watt, 50 Cycle.
24v to 32v input.
Output can be supplied for 50-110 or 240v as required.
Suit radiograms, TV, Tape Recorders, Fluorescent Lights.

$39.75 £19/17/6

450 Watt, as above.

$73.75 £36/17/6

PHILIPS No. 4

COMMUNICATION RECEIVERS
6V Operation, 500 KC to 18 megs.

$45.75 £22/17/6

ntion is that the resulting publication be ed as ready reference by the trained maintenance mechanic. In simple language, the ook explains the diagnosis of troubles and ays to repair DC rotating machinery. Des-iptions of the various DC motors and eir applications are given in the text, nd the different types of windings used in e motors are defined.

The chapters in the book are titled as llows: DC Motor Designs; Preliminary iagnosis; Operating Tests; Neutral Meas-ements; Armature Testing; Armature Re-inding; Field Rewinding; On-The-Job Ser-cing. At the back of the book three arts are printed which are quite handy r reference purposes. These are: Circular il Area of Rectangular Wire; Specifica-ons for Round Copper Wire; Weight of ire Required for 1000 cir. mils per amp.

Even for one not very familiar with elec-ic motors and generators the explanations this book seemed to be quite clear and asy to follow. (K.W.)

* * *

LECTRONIC ENGINEERING MEASUREMENTS FILEBOOK, edited by Stephen E. Scrupski and published by Mactier Publishing Corporation, New York City, for TAB Books, Thurmont, Maryland, U.S.A. Well bound with hard cover, 168 pages, 8¾in x 5½in, with many circuits and illustrations. American price $9.95.

This book is a collection of 44 short rticles, each beginning with, "How o Measure. . . ." These articles were riginally published in the Measurements ile department of EEE Magazine. The reface claims, and with some justification, hat many engineers and technicians doing esign and development work, often have o make measurements in a hurry. In doing o, even if they are aware of the short-omings of the method of measurement ade with equipment readily available, there ould be errors of a serious nature.

The purpose of the book is to present, n concise form, what may be considered o be the best method of making specific easurements with a reasonable economy f equipment. At the beginning of most f the articles, an attempt is made to oint out the pitfalls which can arise in aking the measurement in question and he means of avoiding such problems.

"How to Measure" such things as Small hase Shift in Transformers, Transistor fT, unnel Diode Parameters, SCR Parameters, emperature with Diodes, an · Oscillator's hort-Term Stability, Zener Stability and any others are among the subjects covered n this volume.

In my opinion it could be very useful, rovided the particular measurement tech-ique that is required at the time is covered n its pages. As such, it is worthy of a lace in the technical library of laboratories and of anyone engaged in electronic easurements.

Our copy came direct from TAB Books, hurmont, Maryland. It is reasonable to ssume that copies will be available through Australian booksellers. At the time of writing, no Australian price is available. (ILP)

* * *

OPTOELECTRONIC DEVICES AND CIRCUITS, by Samuel Weber. Published by McGraw-Hill Book Co., New York, 1964. Cloth bound, 8-5/8 x 11 in (Demy 4to.), 360pp., many photographs and diagrams. Price in Australia $15.75.

Samuel Weber is Senior Editor of the American journal "Electronics," and has assembled this volume from a compilation of some 97 significant articles which have appeared in that journal in recent years covering topics within the field of "optoelectronics." This relatively new field represents the overlap between optics and electronics, and deals with lasers, infra-red ranging and detection, electroluminescence, television, information readout, fibre optics, and so on.

The articles are organised in chapters according to the following classifications. 1—Modern Optoelectronic Principles. 2—Laser Design and Application. 3—Optical Communications. 4—Military and Space Applications. 5—Infra-red Systems. 6—Display Systems. 7—Pattern Recognition. 8—Computers and Digital Applications. 9—Industrial Applications. 10—Instrumentation. 11—New Concepts in Television. 12—Unconventional Optoelectronic Devices.

The articles are virtually as originally published, and are of the standard normally associated with "Electronics" articles. Thus the book should be of considerable interest and value to those concerned with optoelectronics, and to those who would like an insight into both the fundamentals and applications of this field. Even those engineers and technicians who subscribe to the journal concerned may wish to take advantage of the convenience and compactness provided by such a compilation; the more so if they missed odd copies.

A well-produced and up-to-date treatment of a modern subject, well worthy of a place on the reference bookshelf.

Our copy came from the publisher direct, but we understand that copies are available from the larger bookstores. (J.R.)

* * *

THE UNION CARBIDE CORPORATION announces the release of a new 28-page brochure giving details of equipment developments in the field of submerged arc welding for steel fabrication. The brochure covers components flexibly designed to meet a wide variety of conventional fabricating jobs and presents examples of numerous specialised applications of submerged arc welding to both in-shop and on-site construction projects. Copies of the brochure are available upon request to: Union Carbide International Company, Division of Union Carbide Corporation, 270 Park Avenue, New York, U.S.A.

THE STANDARDS ASSOCIATION OF AUSTRALIA announces the issue of an Australian standard specification for flameproof cable glands, under the designation AS C357.

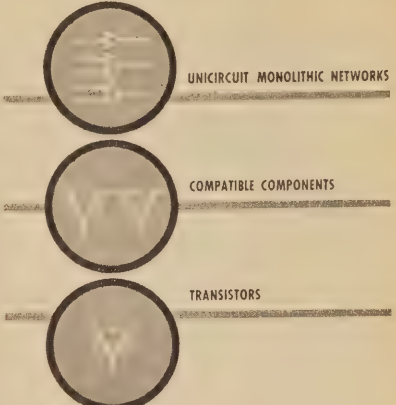
This standard has been prepared by the Association's Committee on Electrical Equipment in Hazardous Locations, in order to provide a uniform basis for the design and construction of flameproof cable glands. It is intended for the guidance of manufacturers, users, statutory authorities and associated interests in this field, and for use with the SAA Wiring Rules.

The standard applies to cable glands for use in inflammable vapour and gas atmospheres, and includes those design and construction features which are considered to be essential to secure safe operation in service.

Copies of AS C357 may be obtained from the various offices of the Standards Association for 80c a copy.

MULLARD OUTLOOK Vol. 9, No. 2 (March-April, 1966) contains the following articles: Mullard Mini Speaker Units, describing a new design for small loudspeaker housings; The Use of Silicon Transistors in the Electronic Organ; A Medium Power Amplifier, containing constructional details about an inexpensive unit using the new Mullard AC187 and AC188 transistors; Mullard Travelling Wave Tubes; Encapsulated Module for Thyristor Control. (Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney.)

NATIONAL BUREAU OF STANDARDS TECHNICAL NEWS BULLETIN Vol. 50 No. 3 (March, 1966) has articles entitled: Gas Meter Provers; Blood Flow Sensor; Floating Weather Station Uses Nuclear Power; Transistorised Modules for Datalogging Systems; Improved Dental Filling; Colorimetric Determination of Gaseous Combustion Products. Also included are details of standards and calibration, N.B.S. publications and news items. (Inquiries to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.)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Queens Road, Melbourne.

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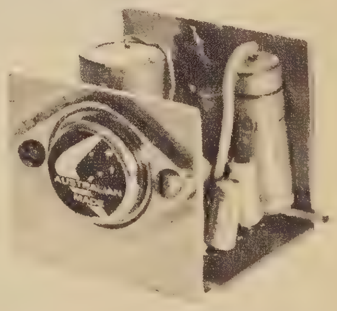

New release!

S.E.W. TRANSISTOR MODULES.
Model 10/20—The Smallest HiFi quality 10 Watt Amplifier in Australia.

AVAILABLE AS KIT
with full instructions or **PRE-BUILT.**
Actual size: 1½" x 1½" x 1½".

Response: 20 c/s—20 K/cs. Output: 10 Watts into 1.5 ohm load. Operates from 4.5 to 15V. PRICE: £7/10/- ($15). Plus Tax. Power Supply £6/12/6 ($13.25). Plus Tax.

Also available Model 25/50 silicon. 25W 15 ohm output.

A full range of HiFi and P.A. Kits available for all purposes from 5 Watts-100 Watts.

S. E. WILLIS TRADING CO.
38 RIVERSDALE ROAD, CAMBERWELL,
E.6, VICTORIA — 82-5787

S.T.C. COMPONENTS AND EQUIPMENT REVIEW, Vol. 3, No. 4 (April, 1966) has information about the following products: I.S.E.P. Thermistors; I.T.T. Intermetall Diodes: Germanium Gold-bonded Diodes; Solid State Rectifier Assemblies for vacuum and gaseous rectifier assemblies; S.T.C. Solid Tantulum Capacitors; EM400-10 Moulded Silicon Diodes; Cathode Ray Tube Type 7BNP10/A for storage display; Moulded Cable Clamps. (Standard Telephones and Cables Pty. Ltd. Moorebank Avenue, Liverpool, N.S.W.).

ACOS CHANGER DUST BUG

PRICE: $5.50

Essential to all who value their records, the Changer Dust Bug clips easily over most changer arms and sweeps the record both before and behind the stylus, at the same time depositing a very fine antistatic film which prevents dust attraction through static changes. Record and styli life can be increased by up to five times with a Changer Dust Bug. Spare fluid, bristles and plush pad are available in complete spares kit.

AMPLION (A/SIA) Pty. Ltd.,
29 Major's Bay Rd., Concord, N.S.W.
Vic. Distributors: E. W. Cornelius Pty. Ltd.,
166 Montagu St., Sth. Melbourne, Vic.

RANK XEROX (AUSTRALIA) PTY. LTD., of 49 Market Street, Sydney, have advised that preparation of reprints of the article on Xerography, which appeared in the March issue of ELECTRONICS Australia, has been delayed. However, reprints should be available by the time this issue is published.

Rank Xerox have also asked us to point out that copies of a second article relating to the preparation of printed wiring boards using the Xerographic process will not be available until after it has appeared in this magazine.

HEWLETT-PACKARD JOURNAL Vol. 17, No. 7 (March, 1966) has two major articles, the first entitled "A Sensitive, Wide Range DC Null Voltmeter With an Internal Bucking Supply for Zero Loading Error" and the second "A Portable DC Voltage Standard Providing 10ppm Transfer Accuracy". A shorter item is entitled "RFI Measurements Down to 10KHz with Spectrum Analyzer Converter."

Inquiries for this publication should be addressed to Hewlett-Packard's Australian agents, Sample Electronics (Vic.) Pty. Ltd., 9-11 Cremorne Street, Richmond, Vic.

ECCOSORB ANECHOIC CHAMBERS is the title of a new publication from Emerson and Cumming, Inc., of Canton, Massachusetts, U.S.A. This 12-page illu rated booklet describes some of the m recently built Eccosorb anechoic chambe This is the fifth of a series of bookl on the subjects dating back to 1960, a provides up-to-date information for th interested in the use of anechoic chamb for aerial pattern and radar cross secti measurements.

Details are given of 11 recently bu chambers with a description of the n and novel features of each, as well performance information. Australian age for Emerson and Cumming are Wm. McLellan and Co. Pty. Ltd., The Cresce Kingsgrove, N.S.W.

NATIONAL BUREAU OF STAN ARDS in U.S.A. has advised availabili of the following new publications:

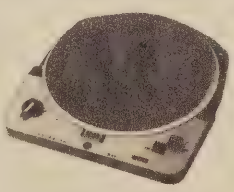
Numerical Simulation of Ionospher Wave Extraction Experiments by Thom M. Georges (N.B.S. Technical Note 32 October, 1965), 42 pages, 30c.

Voltage Ratio Detector for Milliv Signals by J. R. Houghton (N.B.S. Technic Note 266, December, 1965), 11 pages, 15c.

Microwave Impedance Measurements a Standards by Robert W. Beatty (N.B. Monograph 82, August, 1965), 32 pages 20

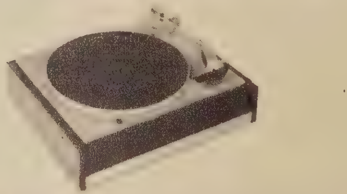
The prices quoted are in U.S.A. currenc Foreign remittances must be in U. exchange and should include an addition 25 per cent on the publication price t cover mailing costs. (Available from Supe intendent of Documents, U.S. Governme Printing Office, Washington, D.C. 20402.)

Stereo equipment?
Only Goldring have it this good.



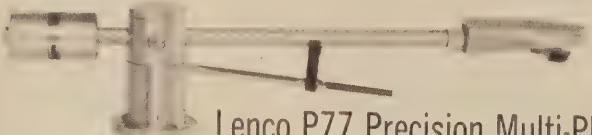
G.99 Transcription Unit

For enthusiasts requiring a unit of high transcription quality, but wishing to use a transcription arm of their own choice.
Features an 8 lb. non-magnetic, diecast, dynamically balanced turntable—fully variable speeds—a vertical drive system and a neon-lit stroboscope.
Wow and flutter is less than 0.2%—rumble and hum are negligible. Turntable speed variation is less than 1% for 13% mains voltage change.



Lenco GL.70 Precision Transcription Unit

Precision engineered GL.70, features an 8 lb. non-ferrous, non-magnetic, diecast, dynamically balanced turntable—fully variable speeds—built in "Micro-lift"—pick-up weight adjustment—detachable head shell—and a vertical drive system. Wow and flutter is less than 0.2%. Optionally fitted with the latest Pickering V15/AM1 low mass, high compliance magnetic cartridge. Compliance = 16 x 10^{-6} centimetres per dyne; Channel Separation = 35 db at 1 KC.



Lenco P77 Precision Multi-Plane Transcription Arm

TECHNICAL SPECIFICATION
Overall length of pick-up arm 330 m.m. (13"). Diameter of pedestal 34 m.m. (1.34"). Overall height with screening can 150 m.m. (5.9"). Maximum height adjustment 30 m.m. (1.18"). Tracking length (turntable spindle to pedestal spindle) 210 m.m. (8.27"). Stylus overhang 17.1 m.m. (0.67"). Maximum adjustment of Stylus position 10 m.m. (0.39"). Offset angle 23° 12'. Tracking error ± 0.8°. Length of cable 1.10 m. (43"). Capacity (plug-in shell to amplifier input) 160 pF. Moment of inertia (without cartridge) 148 grs.^{2}/m.m. Low frequency resonance with cartridge of compliance 5 x 10^{-6} cms./dyne = 10 c/s.

GOLDRING ENGINEERING (AUSTRALASIA) PTY. LTD.

N.S.W.: 443 Kent Street, Sydney. 29-1275/6/7
VIC.: 368 Little Bourke Street, Melbourne. 67-1197
QLD.: 235 Edward Street, Brisbane. 2-3247
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G

For further information on these products send this coupon to the Goldring dealer in your state, asking for the FREE 24-page Booklet on the Grundig World of Sound.

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ADDRESS **STATE**

GE : P316.

ANSWERS TO CORRESPONDENTS

When writing to us:—

- **Please give your name and full postal address, including the State . . . N.S.W. &c.**
- **Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.**

RF STAGE

L.A. (Roseville, N.S.W.) says that he was most impressed by the difference in performance between two otherwise identical transistor radios, one with and one without an RF stage. He asks whether it is possible to add an untuned RF stage to sets which have no RF stage.

We agree, a good RF stage can make a tremendous difference to the performance of a receiver, when used for anything but purely local station reception. The improvement comes about in respect to gain, signal-to-noise ratio and discrimination against unwanted signals arising from better selectivity at the signal frequency. Much of the benefit disappears if the RF amplifier stage is untuned, added to which there is the problem of introducing such a stage, mechanically and electrically, into an existing transistor receiver. Much the same remarks would apply to an untuned RF stage intended to cover the short-wave bands. If the RF stage is to be of real help, it would need to be part of the original design, at least for portable sets.

OLD CAR RADIO

J.S. (Sunbury, Vic.) tells how he stripped an old car radio, using the transformer wire for aerial and earth and the loudspeaker for a simple diode detector and transistor audio amplifier.

We doubt that your contribution would qualify for our "Reader Built It" page since the circuit itself is very elementary and commonplace and there would not be much point in repeating it. Nevertheless, the experience gained will have been useful.

ACOUSTIC EFFICIENCY

K.G. (Wallendbeen, N.S.W.) asks about the system used by loudspeaker manufacturers for rating loudspeakers in terms of acoustic efficiency. He says some manufacturers give a figure of 100dB and asks what is the reference level of 0dB, and what represents 100 per cent efficiency.

We have not used any such terminology in our own editorial text and we would have to do a bit of research to establish how many "conventions" there are and who uses them. When referring to sensitivity, we normally assess a particular unit and relate it to the class of loudspeaker with which our readers are familiar, so that such terms as average, low, high, etc., have a reasonable significance. The approach has sufficed to date but the time may come when our terminology may have to be more precise. We have no immediate plans to describe a Class D amplifier using pulse width modulation techniques. This system was discussed in detail in the June issue, and obviously has its own problems. We have not had much to do with contact microphones but Acos did market a crystal type some years ago. We suggest that you check through your local supplier or direct to Amplion (A'sia.) Pty. Ltd., 29 Majors Bay Road, Concord. N.S.W.

ERRATA

D.C. (The Basin, Vic) suggests that it would be a good idea if we we were to put errata always in the one place in the magazine.

From the readers' point of view, this would be good but it would constitute a reason to hold up yet one more page till the end of the production period. Our constant battle is to get pages away early and minimise the last-minute rush each month, which is one of the very reasons why errors occur. An alternative, which your suggestion has brought to light, is to continue inserting errata, as we do now, in available space but to include reference in the index. This will give readers somewhere specific to look in each issue. As regards the other matter, we often mention in our articles the type number and source of components on which a project depends and for which there is no obvious alternative. However, it would be a constant source of friction if we were to specify one component from one supplier, if other and equally good equivalent components were available from other suppliers. Whatever the position may be in other countries, Australian manufacturers and agents are very sensitive to the brand of components which we use in our projects, and very quick to react if they feel that someone is being favoured unduly.

VIDEO RECORDING

T. R. (Rapid Creek, N.T.) sends us a clipping from a London newspaper forecasting a bright future for cheap, simple video tape recorders.

There was a spate of these predictions a couple of years ago, which we criticised very strongly at the time. The whole implication was that the problems had been solved and we would all, very soon, be recording video on machines little more complicated and little more expensive than ordinary sound recorders. Events have completely vindicated our remarks. To be sure, home video recording will become a reality but only as a result of techniques and components far removed from the audio techniques of past years. You can be quite sure that the difference between audio and video will show clearly in the price!

YEAR BOOK

R.G. (Netherley, S.A.) says that he has several years of issues on his shelf but finds it hard, at times, to locate a particular article or advertisement. He says he would be quite happy to pay an extra 25c each year for a comprehensive index.

We do try to include in each March issue an index to the main articles for the past twelve months, so that bound volumes which date from April to March contain their own editorial index. Apparently you have in mind something more detailed than this covering individual news pars, etc. and even contents of advertisements. From your reference to individual years, you might have in mind a comprehensive index which will be up-dated each year. Frankly, we doubt the practicability of such a scheme, as we would have to sell many thousands of copies, either with advertising and/or at much higher unit price to meet costs. Our immediate reaction is that indexing must be integral with the magazine. To produce a more detailed index of editorial material would be a possibility, though it would cut into the space available in each March issue for other features. To index the content of advertisements, however, would be a formidable task which would assume the proportions of a "buyers' guide," with a further intrusion in to editorial space. However, thanks for the suggestions which we have publicised in such a way that other readers can register their reactions.

DEATH OF A PIONEER

E. W. C. (Heidelberg, Vic.) comments on our recent article on the passing of Syd Colville.

Thank you for your letter. Undoubtedly, such a brief story could have been expanded into a full biography and, equally, many others who have passed on could well have been the subject of interesting stories. In the case of Syd Colville, the research was done and a story written by a contributor who chose to remain anonymous but who wanted to have something on record to his memory. This is the exception, however, rather than the rule, and the colourful personal history of many people dies with them.

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of $0-20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the $0-20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at $0-20 PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost $0-50 (5/-) each. Original photographs of most projects are also available, from $0-50 for a 6in x 8in glossy print, postage $0-08 (9d).

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

(10) A fairly good range of back numbers is available. On issues up to 6 months old there is a surcharge of 5c (6d). On issues from 7 to 12 months old the surcharge is 10c (1/-). Over 12 months, it is 20c (2/-).

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SECOND
IN
ETERNITY

The Ancients called it
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(AMORC)
54 Customs St., Auckland, New Zealand

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TRADE IN BRIEF — con

GENERAL ELECTRIC COMPANY U.S.A. is marketing a new 1.5A recti designed to absorb voltage transients g erated by household or industrial po lines, capable of dissipating up to 1000W the reverse direction. This is achieved using a controlled-resistivity silicon me pellet sandwiched between two hea thermally-matched slugs which draw h from the pellet and dissipate it to hi conductivity copper alloy leads. A transi voltage across the rectifier causes the junction to go into reverse avalanche bre down. The reverse power is distribu uniformly and safely throughout the b of the silicon pellet, thus preventing loc sed heating at the perimeter, which c damage or destroy a rectifier's blocki ability.

The rectifiers are encapsulated in gl to prevent contamination and to elimin internal cavities.

These devices are available in Austra from Australian General Electric P Ltd., 103 York Street, Sydney.

FAIRCHILD AUSTRALIA PTY. LT has appointed Mr George Fraser as natior sales manager. The announcement follo the rapid growth in the company's ope tions in recent months. On May 10, Fa child's new laboratories, built at Croydo Victoria, at a cost of $2 million, we officially opened. These laboratories w enable Fairchild to meet the entire nation demand for micro-circuits and silicon tra sistors. The company expects the dema for these transistors to increase sharply lat this year, when the first Australian-ma transistorised television sets are due appear on the market.

AUSTRALIAN GENERAL ELECTRI PTY. LTD. has received an order fro Davids Pty. Ltd., the largest wholesa grocers in N.S.W., for a GE-115 compute The computer will be used by Davids their new warehouse, currently under co struction, which will have the most mode stock handling equipment and technique

The GE-115 will be used to keep a on-demand record of every item of stoc held in store or on order. Seconds aft the receipt of a customer's order, the syste will ascertain whether goods are in stoc or on order; assemble the invoice in th same order that the goods are stored i the warehouse; prepare the customer's stat ment.

PYE INDUSTRIES LTD., has signed a agreement with Stanelco Industrial Service Ltd., of U.K., for the marketing and dis tribution in Australia of the "Acme" rang of high frequency plastics welding equip ment. The equipment will be marketed b the Pye company's industrial heating sub sidiary, Pye Industrial Electronics Pty. Ltd

Acme plastic welding equipment is use in the manufacture of raincoats, inflatabl toys, automobile upholstery and lingerie. A number of the machines are alread operating in Australian factories.

STANDARD TELEPHONES AN CABLES PTY. LTD., of Mooreban Avenue, Liverpool, N.S.W., has introduce a new range of varactor diodes for use i harmonic generators and up-converters They have been designed to act as low-los voltage variable capacitors at VHF, UHF and SHF frequencies.

The diodes, which are of the silicon-diffused epitaxial type, have gold-bonded internal leads and are hermetically encapsulated with a welded final seal. Three basic kinds of encapsulation are used for compatibility with the types of circuit and frequency of operation employed, but the company can supply alternative tyres of encapsulation to meet special requirements. Typical characteristics are: Stud type, capacitances from 2 to 64 uF, breakdown voltages from 90 to 200V; Cartridge type, capacitiances from 0.25 to 5 uF, breakdown voltages 18 to 120V. ▬

CLASSIFIED ADVERTISING

Advertisements in these columns cost $0.50 per line. Each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. Please note PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES. Your advertisement for the August issue must reach our office before July 7th. Address your advertisement to the Advertising Manager, ELECTRONICS Australia, Box 2728, G.P.O., Sydney.

FOR SALE

O-WAY Radios, TCA FM1674, 25 watt; STC TR10/120A. 10 watt; Pye PTGA2025 and 3 base stations. Frequency as required, over-uled, perfect going order. P.O. Box 69, one 61-5299. Hamilton, N.S.W.

RRARD Autoslim Stereo 4-speed Record-angers. These new, popular, latest model units ailable now, £12. Post and packing: N.S.W., /; Qld., Vic., Tas., 22/6; W.A., S.A., 30/.
PROFESSIONAL TV SERVICE,
Box 36, Queen Vic. Building P.O., Sydney.

L, all back issues "Electronics Aust." in stock all times. 1939-55 copies 20c; 56-59 30c; 960 to date 40c. Post incl. T. WEIR, 56 Connor St., Haberfield, Sydney. 71-2569. anted to buy copies.

PE RECORDER BARGAINS, new and used achines. Buy from a technician, not a sales-an. Free technical advice. All repairs and cessories. Country inquiries welcomed. Tom-n's Radio. 528 Liverpool Rd, South Strathfield. .S.W. 642-4215, Sydney.

GAN COMPONENTS. Send for our illustrated talogue listing parts, kitsets, circuit data and lectronic organ keyboards, pedal boards, con-ct wires, wiper plates, contact blocks, stop witches, stop tabs, piston switches, coupler witches, multi-type relays, toe piston, expres-ion controls, solenoids, etc. Also many sundry arts such as felt strips, springs, felt washers, readed rod and components for pneumatic ction.
For the benefit of experimenters we list sets f data sheets available for several different esigns of organs.
Alan Douglass, transistorised design and the lyde organ construction kitset "Harmonics" re-assembled units and complete organs.
Please send 5/ cheque or postal note to cover art cost and printing and posting. Peska Pty. td., P.O. Box 306, Frankston, Vic.

HER AUTOMATIC TAPE RECORDERS. For hose who want the ultimate in perfection. ound operated relays, built-in 2-channel mixer, uto slide projection, 4 heads, 4 tracks, 4-speed and B monitors, reverb., echo, stereo, mono req. range to 20Kc, plus or minus 3db dynami-ange to 60 db. Wow and flutter less than 15 er cent. channel sep. 50db. V.U. meters, auto. ewind, clutches for tape protection, sound on ound, gold relay contacts, auto. torque controls. emote control, rewind, playback recording stop and start, disconnectable auto. recording level control, batt. and A.C. operation, etc., etc. German made, light and compact. You will never see more features or quality for your money. Push-button control. A dream to operate and own. Prices from £145 to £250/10/. N.S.W. Distributors: Tomlin's Radio, 528 Liverpool Rd, South Strathfield. 642-4215. Country and Trade inquiries welcome.

V PICTURE TUBES:
1-year warranty $10. 2-year warranty $12. Plus old tube. These are Trade Prices.
All types except bonded and 27in. All duds must be under vacuum and scratch free. When ordering by mail, add freight. Sure Brite Picture Tubes, 22a Victoria St. Lewisham. Sydney, N.S.W. Phone 56-6363.

ROADCAST receiver booster kit. This transistorised RF Amplifier will increase sensitivity, selectivity and sig./noise ratio. No alterations to receiver necessary—output of unit connects to receiver aerial socket. Power gain: 20db. Ideal for use in areas of low signal strength. Stops fade. Full price 35/. Hallard Electronics. Box 58 P.O., Campsie, N.S.W.

ENSITIVE Transistor receiver kit. Uses an efficient reflexing circuit employing voltage doubling diode detection coupled to a high gain amp. driving a 5in x 3in speaker. Set is housed in an attractive plastic cabinet. Complete to the last screw. Set makes an ideal gift. Transistor complement: OC169, 2xOC71 and OC74. Full price £7/2/6. Hallard Electronics. Box 58, P.O., Campsie, N.S.W.

OMPONENTS Sale. Resistors, condensers, coils, pots, transistors, speakers, etc. All prices greatly reduced. Write for list. Hallard Electronics, Box 58, P.O., Campsie, N.S.W.

TRANSISTOR Receiver Kit. Range 30 miles. Sensitivity greatly increased with short aerial. Regeneration used. Transistors: OC169 and OC71. Full price 65/. Hallard Electronics. Box 58, P.O., Campsie, N.S.W.

CUSTOM Built Transformers—Power, Audio, etc. Single or quantity production. Battery chargers, rectifiers, electric motors, transistor radios, General engineering, fitting and turning, sheet metalwork, etc. Parkinson Transformers, P.O. Box 523, South Brisbane. Phone Beenleigh 33.

GARRARD SRP10 T'table and arm. Maple case. Cryst. t/o cart. Diam. stylus $25. R. TV & H. 5in CRO (June, 1960) less pwr. sup. $40. P.M.G. relays 2K coils 75c ea. 5 Mont Albert Rd, Canterbury, Vic.

FOR SALE

ELECTRONIC organ. Schober spinet, 12 months' old. Will sell for cost price. Burgin, McGibbony St, Ararat, Vic.

TOP quality recording tapes. 3¼in x 1,800ft PVC, Mylar $1. 5in x 900ft PVC, $1.80. 7in x 1,800ft PVC, $2.69. Over 80 selections from 4 brands. Fully guaranteed. Post free. AIMO, Box 15, Footscray, Vic.

TESTED TV Valves, 6BM8, 6BL8, 6U8, many others, 6/ each. Phone 528-8548, N.S.W.

GELOSO front end kit type 26158 .suitable Communicaitons Eight receiver. New in original carton, $50. Weldon, 11 Raymond Ave, Northmead, N.S.W. 630-2388.

FOR SALE. R. TV & H. 1957/1966 1/ each. R. TV valves. U.L. trans. Speakers, etc. Many at bargain prices. Fitted bench with power supply, Playmaster p.p. U.L. 14w stereo amp. plus tuner, etc. Daily after 6 p.m. and Sat. morns. 54 Day St. Drummoyne, N.S.W.

GRUNDIG television camera type FA40, complete with lens, tripod, panning and tilting head, etc., for use with any television receiver. New, but used for few demonstrations. $340 o.n.o. Contact Mr Wilkins, Instrument Engineering Pty. Ltd., 32 Annerley Rd, Woolloongabba, Qld.

HAMMARLUND HQ100 receiver/sp. $150. Thorens TD124 AR2a speakers, preamp and 2 CH, 35 watt amps, $500. Elco test eq: 5in CRO 460, $65. Elect switch 488, $15. Sweep gen. 368, $55; RF gen. 324, $20. Robert Francis, 88-5555 or 71-9280, Sydney.

NEW OC44, 45, 71, 60c ea. OC72, 73, 74, 2N217, 2695, 70c each. OC84, AC128, OA210, 75c each. OC171, 2N370, 371, AF116N, 117N, BYZ13, OA31, 211, $1 each. 2N301, 257, $1.20 ea. OC23, 28, 29, 35, $1.50 ea. OA5, 10, 81, 85, 91, 95, 30c ea. New recording tape, double play, 2,400ft 7in Reel, $3.50 ea. No S.A. Sales. Pack. and Post., 15c. Custom Electronics, Box 1452, G.P.O., Adelaide.

DESIGN and build small power transformers from fully detailed charts and text, send $1 for copy by return mail. Modern Products, 18 Bridge Rd, North Ryde, N.S.W.

MODEL Engineering. "C38" Locomotive, 2½in gauge. Blueprints, castings. Bolton, 72 King St, Sydney. Catalogue 75c. N.S.W.

AR-7. Comp. rebuild with mods. Perfect order Boronia (72) 22485, Vic.

COLOUR film. Camcolor 35mm 20ex. 2 for $3. Mtd. proc. $1 ea. Camera Supply Co., 123 Walker St, North Sydney. 92-8703.

STEREO ADC3 diamond, magnetic cartridge, AKG phones, exc. order, $10 ea, Gramdeck tape rec., good, $20. Kelly C-O, Rola 5FX, 4-inp. Mixer, $4 each. R. Freeman, C/o Bailey Bros., Glenrowan, Vic.

GRUNDIG TK46 stereo tape recorder c/w microphones and foot control. Excellent order. Owner going overseas. $250 or near offer. Phone Adelaide, 71-1321, S.A.

1966 Summer Supplement of World Radio-TV Handbook, just arrived airmail, only a few at $3.25 each. Latest issue. Robert Ronai, P.O. Box E73, St. James, N.S.W.

PYE PTC8702. Two-way Base station. Three mobiles type PTCA8002 complete. FM Hi-band, present frequency 157.54 MC, $500. Bluncks Garage, Beaudesert, Qld.

NOMBREX portable equipment. Signal generator 150KC to 350MC at 2 per cent. C.R. Bridge 1 ohm to 100 Mohm and 1pF to 100uF at 2½ per cent. Audio generator 10cps to 100KC, 1 volt p to p, sine or square. S.A.E. for technical leaflets. Trade supplies. Mark Scott Enterprises, 14 High St, Kensington, S.A.

SPECIAL clearance of new Transistors and Diodes, 2N670, 2N1009, 700pv/750ma, 75c ea. or 10/$7. 2N43, 2N117, 2N218, 2N219, 2N333, 2N338, 2N650, 2N702, 2N1038, 2N1149, 2N1305, 2N1755, 2N2552, 2 amp. 200 pv. 3 amp. and 5 amp. diodes for small batt. charg. 1700pv/750ma, all at $1 ea. 1N3017, 1N429, zeners, 2N703, 2N657, 2N1718, 2N2479, $1.25 ea. 7 amp. SCRs, 3N35, $1.50 ea. 2N457A, 2N2151, 15A SCR, $2.50 ea. 2N1724, $3 ea. 2N511a, $3.75 ea. Germ. and sil. sig. diodes, 15c ea. or 10/$1.20, assdt. trans. and diodes, 40c ea. or 10/$3.50. Limited quantities, give alternatives. Post and Packing 25c, over $10, Post free. No lists available. M & R Electronics, 309 Antill St, Watson, A.C.T.

READER SERVICE

TAPE to Disc Service.. "John B," 37 Halley Street, Fivedock. 83-8336.

READER SERVICE

X20 Amplifier (built) $33.50; X10 Amplifier $19.50. MAT20, MAT100, $1.55; MAT121, MAT101, $1.70. Sinclair Micro-amplifier, gain 60db (1,000,000) $5.30; OC28, OC35, $1.65; OC71, 75c. Send S.A.E. for EQ list. Mark Scott Ent., 14 High St, Kensington, S.A.

ELECTRONIC ORGANS. Do not build yourself an organ without first consulting us. Send for initial information on the superb Schober (U.S.A.) build-it-yourself kits. No stamps required. The Electronic Organ Co., 124 Livingstone Ave., Pymble, N.S.W. (Mail only.)

MICROGROOVE discs from your tapes. Also tape copying service. Highest quality discs at all speeds, prompt service. Moderate charges. Country and interstate inquiries welcomed Vitatone Recording Studios. Box 18, Post Office, Lane Cove, N.S.W. Phone (Sydney) 42-6154.

TAPE to disc service. Take advantage of W and G Records' professional experience when next needing a tape to disc service. W. and G. Record Processing Co., 185 a'Beckett Street, Melbourne. Tel. 329-7255.

ALLIED Electronics Agencies. Importers, wholesalers, specialised electronic equipment, Japan, U.S.A. 34 Matheson St, Virginia, Qld.

REPAIRS to receivers, transmitters. Construction, testing, TV alignments, Xtal convs., any frequency, $48 plus tax. Eccleston Electronics, 146a Cotham Rd., Kew, Vic. 80-3777.

CONVERT any television to sensitive big-screen oscilloscope. Only minor changes required. Illustrated plans $1.25. P. T. Hole, 43 Taronga Parade, Caringbah, N.S.W.

TAPE RECORDER OWNERS! Join Australia's most progressive tape recording organisation offering a monthly magazine — "The Microphone," bi-monthly "Newstapes," and full discount service. Full details are available from the secretary, A.T.R.S., Box 9, P.O., Crow's Nest, N.S.W.

"FOREIGN FORUM" MAGAZINE, 80,000 world readership, imp. export info. and assistance 6 issues $2. Preview 8c. E. Thompson, 2 Shaw Road, Doubleview, W.A.

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Amateurs! Your chance to Buy Easy! Parts for "Playmaster" and all other designs. Specialising in electronic organ components and kitsets. All parts are of the best make by leading manufacturers. Fully guaranteed. Normal prices. Simple "Lay-By" scheme will make it possible to build your desired project step by step without waiting unnecessarily. Advisory Centre for Amatuers. Hundreds of circuits and a lot of technical data available. Delivery throughout Australia — Tasmania and New Zealand. Send your orders or write for further information to "Oscar Electronics" 9 Matlock Road, Sth. Wantirna, Melbourne, Vic.

TRANSFORMERS rewound. Output, or mains and specials made to order. Paris Radio Electronics, 7a Burton St, Darlinghurst, N.S.W. 31-3273.

POSITIONS VACANT

TELEVISION TECHNICIANS FOR NEW ZEALAND, TISCO (N.Z.) LTD., New Zealand's largest TV Service Company, require top grade TV technicians for many of their 30 Branches throughout New Zealand.

Wages £A25 per week, plus fringe benefits. All overtime after 5 p.m. Monday to Friday, and all day Saturday paid at full penalty rates. No Sunday work.

Air fares for technicians and dependants paid in full.

For further details, write in confidence, enclosing copy of references to:

The General Manager,
TELEVISION INSTALLATION AND SERVICE CO. LTD.,
P.O. Box 9332,
Auckland,
NEW ZEALAND.

MAN, able to repair electrical meters and instruments, can earn good money in spare time. Apply P.O. Box 151, Double Bay, or telephone 36-4401, N.S.W.

WANTED

WANTED. Wharfedale Super 12CS/AL speaker. V. Forbes, 6 The Parade, Clayton, Vic.

WANTED. A.W.A. 7-band radio console, mantel, or gram. Any cond. Good price. Details to B. J. Southwick, 36 The Avenue, Windsor, Melb., Vic.

ALTEC Lansing 604B. Exchange for 604 C-D or will buy 604 C-D. C. Caldwell, William St, Goodna, Qld.

CLASSIFIED ADVERTISERS

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To the Advertising Manager,
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Sydney.

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.... STATE ....

- *Please insert the following advertisement in the .... issue*
- *I enclose P. Note/Cheque for $....*

£....s....d.... being full payment for .... lines at $0-50 (5/-) per line.

☐ FOR SALE ☐ WANTED ☐ READER SERVICE ☐ POSITION VACANT

Please write in block letters with ink or ball-point pen. Number of insertions

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Guarantee yourself a complete set of issues for your library with no copies missing.

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